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PHILIP K. DICK

CONQUERED THE MOVIE WORLD (20 YEARS AFTER HIS DEATH)

PLUS:

UMA THURMAN,

STAR OF **PAYCHECK**, ON THE SECOND COMING OF PKD

ALSO

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I WAS A HACKER FOR THE MOB

BILL JOY ON WHYLINUX SUCKS, NANOBOTS, AND LIFE AFTER SUN

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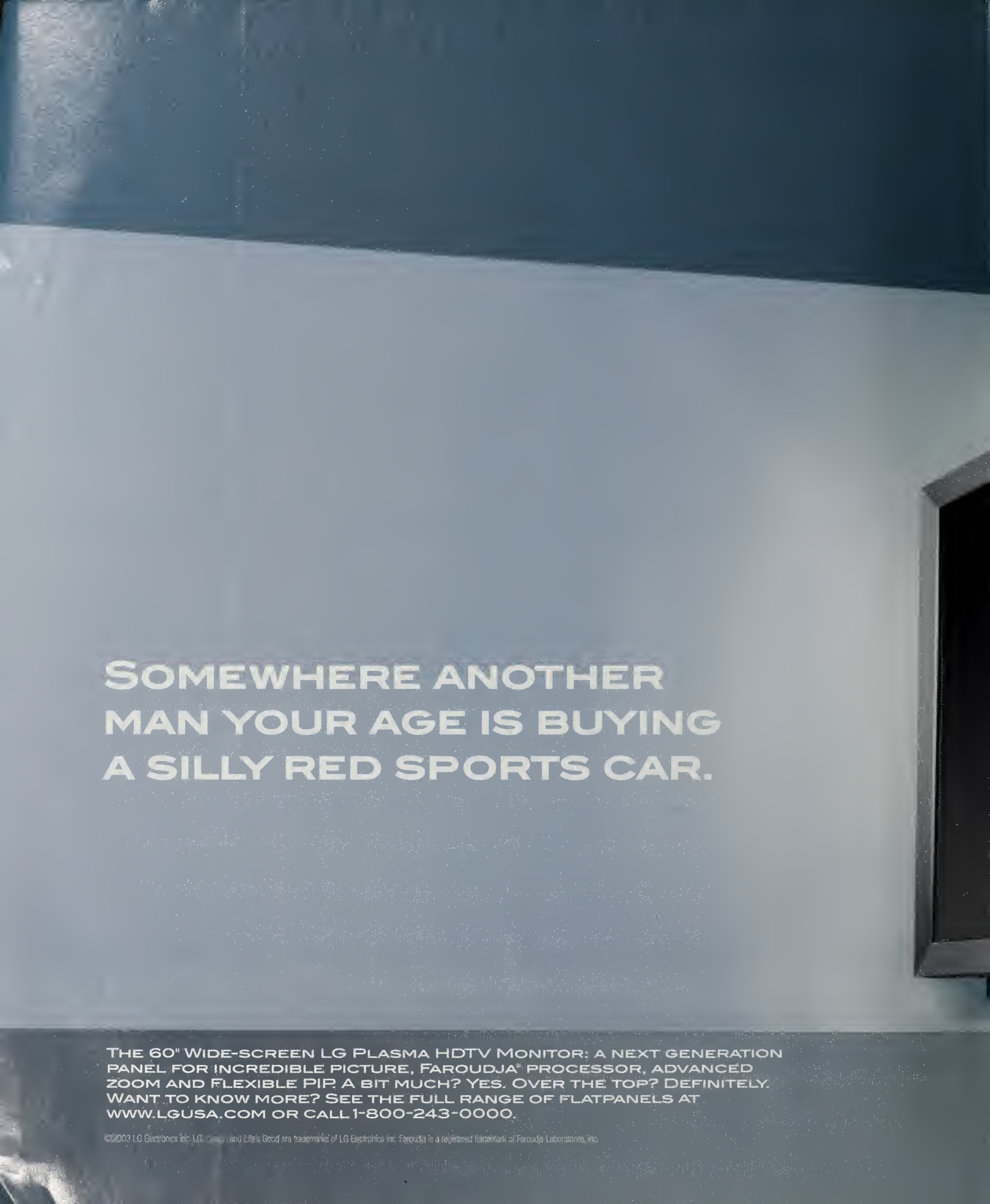

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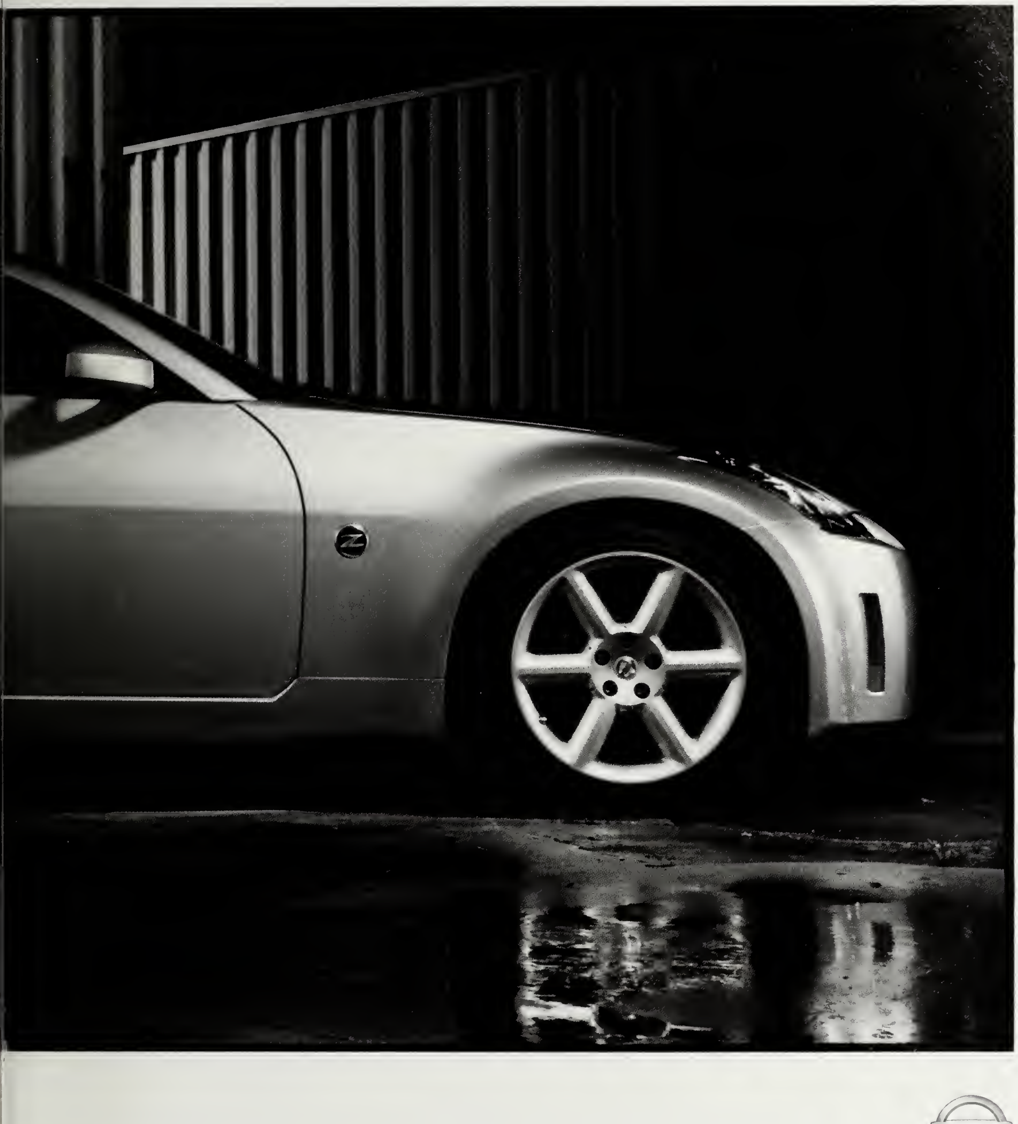

NISSAN

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DO YOU WANT A DRINK OR DO YOU DESERVE A BELVEDERE?

Dear Mr. Webster defines *want* as "inclination; lack; require" and *deserve* as "to have a right to because of acts or qualities; to be worthy of; merit."

Inclination vs. worthiness.

Requirement vs. merit.

Herein, dear reader, lies the difference between wanting a drink and deserving a Belvedere, Poland's finest rye-crafted vodka.

Let us explain.

First, let us point your attention to two words — two beautiful Polish words — that grace every bottle of Belvedere: *na zdrowie.*

Those words are at once poetic, proverbial, public and sentimental; in other words, those words are a Polish toast simply meaning *cheers.*

However, there is nothing simple about the well-offered *na zdrowie* toast. It is an elegant medium through which such feelings as love, respect and admiration can be deeply and sincerely expressed.

It is not to be offered lightly, lest it become ubiquitous and mumbled, offered from habit rather than from any sincere sentiment — the Cro-Magnon *here's mud in your eye!*

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Socrates earned his *na zdrowie.*

® earned its *na zdrowie.*

$E=mc^2$ earned its *na zdrowie.*

Liverpool earned its *na zdrowie.*

Secretariat earned his *na zdrowie.*

And, more recently, New York City earned its *na zdrowie.*

Recalling our friend dear Mr. Webster again, he defines *earn* as "to get as a result of merit: as, 'his remarks *earned* him the praise of everyone.'"

Or, in our own Polish words, "his remarks earned him the *na zdrowie* of everyone."

Everyone, we must raise our glasses and shout *na zdrowie* to the rigorous endeavors of people, events, ah-has, institutions, dates, achievements and — in Secretariat's case — animals worthy of our embrace and acknowledgement.

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Na zdrowie!

It is, after all, only fair. We need only to recall what Longfellow wrote, as only Longfellow could write, in *The Ladder of Saint Augustine*: "The heights by great men reached and kept / Were not attained by sudden flight, / But they, while their companions slept, / Were toiling upward in the night."

Or in other words, as Noel Coward once boasted, as only Noel Coward could boast, "Success took me to her bosom like a maternal boa constrictor."

Achievement, both large and small, deserves our collective *na zdrowie*. And since we are a company involved in the making of the finest vodka in the world, yes, we have a suggestion for which rye-crafted beverage should accompany every well-offered and well-deserved *na zdrowie*:

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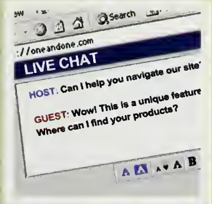

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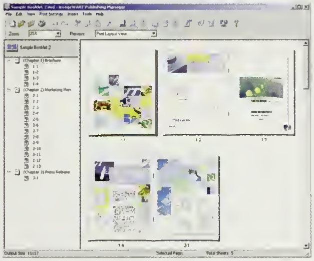

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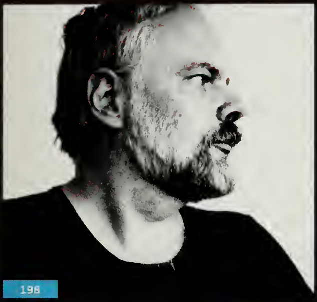
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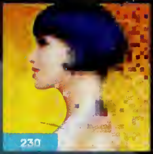
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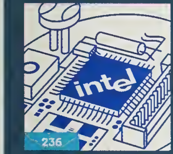

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BOB AND SPARKY'S PRIME TIME

7:00 pm	7:30 pm	8:00 pm	9:00 pm
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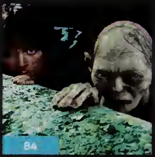

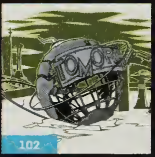

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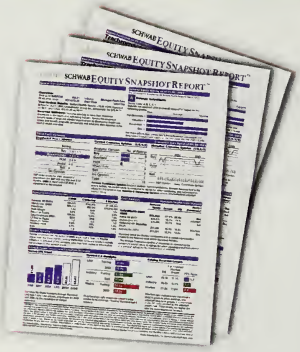

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RANTS+RAVES

"Do Not Boil!!!" by Maja Klüver.

WIRED
THEY CAME FROM THE DIGITAL UNDERGROUND. NOW THEY RULE THE MUSIC INDUSTRY.
SUPERPRODUCERS

Bring the noise: October's "Superproducers" package raised the roof, but it was an essay in View that really got the *Wired* faithful to sound off. "Religion Be Damned," by evolutionary fundamentalist Richard Dawkins, had atheists singing the biologist's praises. On the other side of the aisle, one righteous reader demanded the blasphemer get down on his knees and pray: "Try it, Richard. I dare you." The drifters story, tracking the growth of skid-racing, also got people plenty revved up: "You are just writing about a subculture that's mad it can't afford a real sports car." Meanwhile drift fans petitioned to block ugly-American translations of the seminal manga *Initial D*. (How's this for a new title: *All Your Brakes Are Belong to Us*.)

Finally, a note to the Salt Lake City devotee of Japanese Schoolgirl Watch who mourned the section's absence in the October issue: Turn to page 96 – you'll get an eyeful.

Production Value-Added

It's about time the creative minds behind music ("Superproducers," *Wired* 11.10) got their overdue respect and props. It would be great to know what tools these superproducers use to make their hits. They might not be willing to give up their trade secrets, but maybe *Wired* could do some independent research on the latest drumbeat programs, sampling applications, and digital recording software. You wrote, "The tools of professional sound production keep getting faster, cheaper, and smaller." So share the creative freedom they offer and open the floodgates to up-and-coming producers.

Toby Walker
Arcata, California

It's time to redefine the way people think about music. Stop calling it art and start calling it "musifacturing."

While Pro Tools and similar products have empowered amateurs and semiprofessionals, they have also given big-time producers the ability to manufacture cheap mutations of their music rather than create. The superproducers may have hit on a fresh angle back in the day, but too many have taken their styles and burned them out.

Besides, what good is it to have street cred and the tools to bang out a song on a laptop, when for each musifactured tune on the radio there are a half-dozen amateur pieces with infinitely more charm and allure?

Pedro Bonano
Albuquerque, New Mexico

You chose to use a threatening, in-your-face, dead-ass stare from a black man to showcase superproducers. Isn't music a celebration? Where's the smile? Do black people always look so threatening? Music is beautiful – from hip hop to blues to classical. Let's have some positive attitude, please. The kids are modeling all this shit; let's reinforce a little brotherhood.

Wayne Zebzda
Kauai, Hawaii

Tragic Parting

As someone who has had neurosurgery, I want to compliment you on your excellent and sensitively written article about the Bijani twins ("Till Death Do Us Part," *Wired* 11.10). It was a tragic and traumatic situation for everyone involved. If only they had attempted this in stages as Ben Carson recommended.

MRI technology is a marvelous window into the brain and body, but I'm sure there will be even greater technological strides in both development and application. Without this technology, I might not be writing to you today.

Mimi G. Kimbrough
Newark, Delaware

I'm struck by the issues of financial conflict of interest for Singapore's Raffles Hospital and patient positioning for the angiogram. Even though the patients were apparently extremely motivated to be surgically separated, this does not diminish the ethical duty to think about conflict of interest, especially when the risks are so high.

Katrina A. Bramstedt
Director, Research Subject Advocacy Program
Department of Bioethics, Cleveland Clinic
Cleveland, Ohio

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FROM LEFT: SACHA WALDMAN; CRAIG MAXWELL

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"TO SUGGEST THAT DRIFTING IS SOMETHING NEW IN THE U.S. IS ABSURD."

Get the Drift

To suggest that drifting is something that we in the US are just now getting introduced to is absurd ("Go, Skid Racer, Go!" *Wired* 11.10).

Before wings were introduced to Formula 1 cars in 1968, four-wheel drift was a fact of life for Grand Prix racers. This is made instantly clear to anybody who tries to play the 1998 PC game *Grand Prix Legends* – a game that has a cult fan base, in large part because its physics engine so expertly models four-wheel drifting.

Not knowing about *Grand Prix Legends* may be forgivable, but not recognizing that just about every rally game released in the last four years has had a well-developed drift engine – notably 2001's *Rally Trophy* – is nothing but a display of total ignorance.

Aran Johnson
Oakland, California

This guy in Japan may have made a sport and called it drifting, but it reminds me of what we did with old Fords, Chevys, and Plymouths. Take a front-heavy car with a big V8, slide into the turns, and power around them. Many Americans have been doing this since the 1950s. Maybe it's another one of those, invented here in the US and made practical for all by Japan.

Keith Wheeler
Atlanta, Georgia

If you want to see outrageous, high-performance driving by folks who are absolute masters of car control, you should check out the World Rally Championship races. Those guys (and gals, sometimes) know how to *drive*, and the cars are monsters handbuilt by some of the world's largest manufacturers, like Ford and Subaru. Several years ago, the governing body had to tone down the cars by limiting horsepower – 800-plus was the norm. You can see WRC events on Speed (the TV channel). Watch Marcus Gronholm take his Peugeot around a dirt corner at 100-plus mph, and you'll know what I'm talking about.

Roger Webster
San Jose, California

All in the Family

Robert Edwards' work represents the "we'll do this because we can" view found in abundance among those doing biomedical research ("Test-Tube Family Reunion," *Wired* 11.10). While I don't fault the Browns or any of the others with fertility problems, in my view it's like the guy who writes computer viruses or invents bullets that can shoot through body armor: Amazing accomplishment, but why do it? Is this helpful? Not really, it seems to me.

Ken Kraska
Ann Arbor, Michigan

Play It Again

How could you write an article on the state of the DVR ("The Fast-Forward, On-Demand, Network-Smashing Future of Television," *Wired* 11.10) and not mention ReplayTV?! This is the machine that introduced the 30-second skip button and the only company to sell a DVR with automatic commercial advance. It is also the first DVR to have broadband connectivity, unit-to-unit streaming, and Internet show-sharing.

Michael Aronoff
Calabasas, California

Paying the Price

If illegal downloads have cost the music industry a billion dollars (Start, Infoporn, *Wired* 11.10), what about the cash it loses because of the thousands of retail stores that buy, trade, and sell used CDs? Do you really think Jimmy Page and Robert Plant get a dime of royalty every time a used copy of *Led Zeppelin III* is bought, traded, or sold? Yet I don't see the record industry coming down on Media Play or Amazon.com. It seems that as long as someone is making money – no matter who – it's OK. But as soon as someone tries to give music away, it becomes a crime.

Michael Northrop
Salt Lake City, Utah

As a fan of *Wired*, a music lover, and a consultant to the entertainment industry, I have to express my disappointment with Rebecca Harper's Infoporn on "the forces behind falling music sales." The article mockingly enjoys the demise of the industry; it also depicts and ultimately confuses the relationship between cause and effect. Clearly, the music industry needs to improve in a number of areas and will continue to evolve. Let's be honest, though: Articles like this are written for the simple reason that a lot of people want to hear these emotionally charged criticisms to justify stealing music. Give your readers something meaningful to think: People who steal aren't customers, they're thieves.

Bryan Kindland
Atlanta, Georgia

Not So Bright

Richard Dawkins introduced half a meme when he suggested atheists, agnostics, Darwinians, and other assorted thinkers adopt the label *bright* (View, "Religion Be Damned," *Wired* 11.10). Methinks the word is good, but the meme truly comes to life when the spelling is rendered *brite*, as in sprite. Hell, how about brite sprites?

John Bailey
Scotts Valley, California

At least *Wired* got the headline right – Richard Dawkins preaches atheism. Amen.

As a card-carrying "dim," I am not buying all this pseudoscientific jive about objectivity. Scientists are totally out of bounds when they make the leap of faith from the realm of data and observations to metaphysical speculations. There is nothing in all the so-called scientific theories of origins and ontology that was not offered for consideration by the ancient Greeks. There is certainly much better data, but no better ideas. Brights can't see the light for a very simple reason – they are blinded by themselves.

Myles Dempsey Jr.
Easton, Connecticut

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RANTS+RAVES

Unlike the term *gay*, which has a positive connotation of self-expression, *bright* shows an exclusivist distinction by implying a connection between intelligence and a particular worldview. If so-called brights seek to avoid the stereotype of intellectual elitism, then I urge them to make another choice.
Jon Crowe
Wenham, Massachusetts

Dawkins' article about brights takes on the flavor of an impotent coming-out manifesto. His "atheists are people too" argument seems stale, elitist, insecure, and bigoted. Does anybody actually believe science and God are mutually exclusive? This outlook seems as sorely old-school as his selfish gene idea.

The smooth-sounding sobriquet is nothing more than a small-minded attempt to correct a perceived image problem. The attempt betrays a laughable lack of intuition about how language evolves: He conjectures that the word *gay* had something to do with historical improvements in tolerance among the very same American majority he derides for its faithful idiocy. As *gay* needed *straight*, will *bright* require a catchy antonym? What will we call Dawkins' beloved American majority then? Darklords? Dims? How about Gloomy Gloomers?
Eric Jol
Ottawa, Ontario

I recently attended a meeting of a bunch of my fellow gays and we decided to give up our happy title. We are handing it over to Richard Dawkins and all atheists, agnostics, et cetera, so they may use it to identify their "nonspiritual" orientation. We believe that because the word worked so well in making us a happy and popular minority, as Dawkins asserted, then it will no doubt do the same for the poor, put-upon nonbelievers of the English-speaking world. In return for our great sacrifice, we homosexuals would now like to be called brights. We think the word will really suit us better, since not only does it imply that we are happy (like *gay*) but also that we are clever. Truthfully, most homosexuals I know (including myself) are bright (meaning as smart as atheists). Therefore, using Dawkins' reasoning, since most homosexuals I know are bright (meaning as smart as Dawkins), then I bet that there's a statistical tendency for homosexuals to be bright. Wow, science is easy the Dr. Dawkins way!
Jack Hanley
Brooklyn, New York

Public Works

Joseph Stiglitz (View, "The Dark Side of the Boom," *Wired* 11.10) claims "the majority of innovation comes from public investment." That debatable statement (what about the work of Thomas Edison and Dean Kamen?) ignores the fact that his three examples – the Net, radar, and jets – were initially funded for national defense, the job of every government. The improvements and applications that turned these innovations into everyday things were done largely in the private sector. Perhaps Stiglitz has quit working as an economist to become an ideologue, just like Paul Krugman.
Christopher Glick
Tokushima, Japan

Nice Shades

The October issue features the Ray-Ban Remembrex artifact from the future (Found, *Wired* 11.10). Holy crap, I hope we're not still wearing suits and ties in 2015. Can't someone help men's fashion by then?
Ralph M. Eronemo
Bellevue, Washington

UNDO
Keep Those Options Open:
Neither Ken Lay nor Frank Quattrone were charged with abusing stock options (Start, *Wired* 11.10).

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The Golden Age of Gadgets

Ever since Apple's little MP3 player, the best toys come from the PC biz.

by Sonia Zjawinski

From the people who brought you the beige box and the 35-pound monitor comes a new era in consumer gadgets. Seriously. Apple introduced the iPod two years ago, and Gateway followed with its "must-see TV," a giant, flat-screen plasma model that sold for less than $3,000. This holiday season, Hewlett-Packard is banking on digital cameras and handhelds, and cut-rate PC purveyor Dell is getting into the game with PDAs, TVs, portable music players, and an online music store.

That's critical mass. Consumer electronics of all kinds are increasingly digital, and computermakers are using their expertise to improve our toys. Better, more efficient devices are making their way into our homes. The third age of gadgets – the golden age – is about to begin.

The first era of consumer electronics, the copper age, started after World War I with the radio. Everything more or less worked. Cameras didn't crash, and a consultant was someone who helped with your taxes, not programmed your television. The products were simple, of course, and had only a few knobs and buttons – Power, Volume, Play. They were simple, single-minded, and never mingled.

With the mid-1980s came the plastic age. Computers replaced typewriters; CDs replaced cassettes. Analog devices like audio and video players, televisions, and cameras struggled to converge. But they were still stand-alone islands of proprietary technology, loosely connected by lowest-common-denominator cables. No matter how digital the electronics got, the

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← companies that made the gadgets were still stovepiped; suites of devices worked in perfect harmony – as long as they all wore the same corporate logo. If you managed to force a Sony receiver to work with a Panasonic TV, you lived in a rat's nest of cables with a coffee table covered in remotes and a spouse who couldn't turn on the television without a briefing.

Why didn't consumer electronics firms compromise on standards for interoperability? Because they're jerks. In the plastic age, gadget technology – and therefore any gadget – had to compete for shelf space at minuscule cost margins. Rather than sit down to iron out one superior system, companies wasted time fighting: VHS versus Beta, MiniDisc versus CD, USB versus FireWire. Common standards, it seems, don't lock consumers into brand loyalty.

This is where the PC industry comes in and the golden age begins. If traditional electronics firms were all about exclusivity, computermakers are all about common standards and commoditized parts. And the PC folks know how to implement software-based systems. They know that if documents, pictures, video, and music are merely streams of 1s and 0s, it makes sense to put software in computers, cameras, and DVD and CD players. And they know how to do it for less money.

Sony had a shot at launching this new age. But its competent, snazzy computers fall into the old stovepipe trap. The Memory Stick is great, unless you want to connect with another company's product. These guys won't even call FireWire "FireWire." But more important, Sony's consumer electronics divisions are tanking for lack of parts. The company uses 840,000 different components – Sony says it'll slash that to 100,000 by 2005. Toshiba made similar promises for similar reasons. But computer manufacturers learned the parts lesson a decade ago – streamlining their supply chains made them more competitive. Computer guts are computer guts, and going digital means putting the same chips and circuits in every device. In the computer industry, commodification reduces manufacturing costs (improving razor-thin margins) and guarantees inter-operability. It'll work with consumer electronics, too.

What comes next? Device compatibility. The PC industry was built on the understanding that consumers buy accessories from multiple companies, and, in order to maintain customer loyalty, products will be competition-friendly. Digital cameras and peer-to-peer music and video-sharing have turned the PC into a household entertainment database. Once computermakers pour their experience into electronic gizmos, that PC will become an entertainment server, linked to a home network of speakers, portable devices, display terminals, and so on. Want your USB 2.0 products to play with your FireWire toys over Wi-Fi? Go for it.

What does your average gadget buyer get out of this? Cheaper stuff that works, works together, and resists obsolescence.

The harbinger of all this change was the iPod. One benefit of any digital technology is that its firmware and software can be updated regularly. You don't have to buy new hardware to stay current – just upgrade your device's operating system and applications every now and then. The iPod is, after all, just a hard drive in hot pants – and that's the secret of its success.

Sure, computers have a few problems. When's the last time you needed to call tech support for your Walkman? Plus, it's been a while since the PC industry was heralded for tech advancements – innovation has devolved into a gigabyte fight.

But that'll change. Unlike electronics companies, computermakers aren't limited to their own R&D departments. They're partnered with thousands of small firms worldwide doing frontline research. The little guys leapfrog each other, and the big guys reap the benefits. And you can forget about waiting months to get the latest tech. Gateway and Dell both build for speed. Most of their competitors sealed their holiday lineups months ago, but these two often hawk early-adopter tech within weeks of its manufacture.

This is the world electronics companies made, after all – they taught us to expect the newest, coolest, smartest toys. Only now it's the computer companies that are giving them to us.

Sonia Zjawinski is an assistant editor at Wired.

YOU GET CHEAPER STUFF THAT WORKS, WORKS TOGETHER, AND LASTS

Recalls for 2004

The California governor and the Segway have already been recalled. Why stop there? Here are some more space-hogging files to delete from memory:

☐ RealPlayer
☐ 50 Cent's "Wanksta" ring tone
☐ Tom Siebel
☐ the Memory Stick
☐ Bikram yoga
☐ gluten
☐ Carrot Top
☐ The WB's fall lineup
☐ brand extension
☐ being meta
☐ magazine lists

Not hot: Bikram yoga.

MUSIC INDUSTRY DEATHWATCH

It's P2P Payback Time!

Is it the end of the world as we know it? **Kazaa is suing the record labels.** The file-swapping rebel alleges that Big Music tracked down P2P-ers with Kazaa software, which constitutes an unauthorized use. This sounds strangely familiar. Also, bid a wistful **farewell to Tower Records.** The Sacramento-based mega-retailer, facing bankruptcy, plans to sell itself off. One buyer leading its wish list: Kazaa.

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Fans see a smashed electric guitar.
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Library at Art Center College of Design

Location: Pasadena, California
Cost: About $24 million
Opens: 2005-2006
Fans see the heart of the college.
We see a coiled snake.
Beware of the final design.
While in town check out the pocket-sized Japanese Tea Garden at the Huntington Library.

Walt Disney Concert Hall

Location: Los Angeles, California
Cost: $274 million
Opened: October 23, 2003
Fans see a ship at full sail.
We see brushed-aluminum half-pipes.
Beware of questionable acoustics – because it isn't a concert hall or anything.
While in town check out the Donut Hole in La Puente (shaped like a donut) and Tail o' the Pup in West LA (shaped like a hot dog).

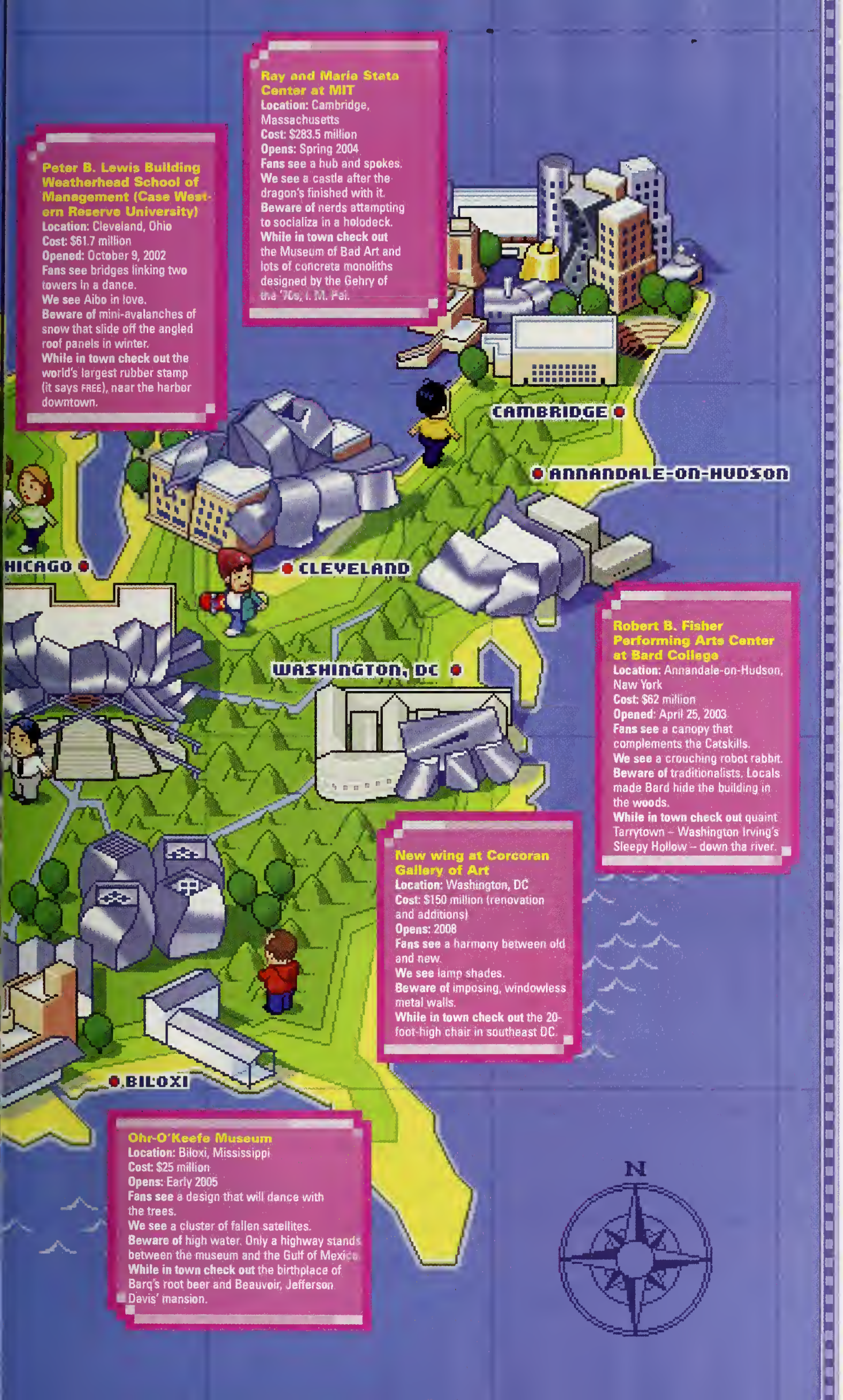
Frederick R. Weisman Art Museum

Location: Minneapolis, Minnesota
Cost: $14 million
Opened: November 21, 1993
Fans see the rippling surface of the Mississippi River.
We see a tin can by Picasso.
Beware of the blinding reflections as you drive across the nearby bridge.
While in town check out the 55-foot statue of the Jolly Green Giant in Blue Earth, Minnesota.

Millennium Park Music Pavilion and Great Lawn

Location: Chicago, Illinois
Cost: More than $63 million
Opens: July 2004
Fans see a folded linen shawl as painted by Vermeer.
We see aluminum foil Fritos.
Beware of angry neighbors. The new Music and Dance Theater of Chicago next door had trees planted on its roof to block out noise from the pavilion.
While in town check out the people in funny-colored jackets shouting and gesturing at each other in the Chicago Mercantile Exchange.

TOTTO RENN



Ray and Maria Stata Center at MIT
Location: Cambridge, Massachusetts
Cost: $283.5 million
Opens: Spring 2004
Fans see a hub and spokes.
We see a castle after the dragon's finished with it.
Beware of nerds attempting to socialize in a holodeck.
While in town check out the Museum of Bad Art and lots of concrete monoliths designed by the Gehry of the '70s, I. M. Pei.

Peter B. Lewis Building Weatherhead School of Management (Case Western Reserve University)
Location: Cleveland, Ohio
Cost: $61.7 million
Opened: October 9, 2002
Fans see bridges linking two towers in a dance.
We see Aibo in love.
Beware of mini-avalanches of snow that slide off the angled roof panels in winter.
While in town check out the world's largest rubber stamp (it says FREE), near the harbor downtown.

Robert B. Fisher Performing Arts Center at Bard College
Location: Annandale-on-Hudson, New York
Cost: $62 million
Opened: April 25, 2003
Fans see a canopy that complements the Catskills.
We see a crouching robot rabbit.
Beware of traditionalists. Locals made Bard hide the building in the woods.
While in town check out quaint Tarrytown – Washington Irving's Sleepy Hollow – down the river.

New wing at Corcoran Gallery of Art
Location: Washington, DC
Cost: $150 million (renovation and additions)
Opens: 2008
Fans see a harmony between old and new.
We see lamp shades.
Beware of imposing, windowless metal walls.
While in town check out the 20-foot-high chair in southeast DC.

Ohr-O'Keefe Museum
Location: Biloxi, Mississippi
Cost: $25 million
Opens: Early 2005
Fans see a design that will dance with the trees.
We see a cluster of fallen satellites.
Beware of high water. Only a highway stands between the museum and the Gulf of Mexico.
While in town check out the birthplace of Barq's root beer and Beauvoir, Jefferson Davis' mansion.

jargon watch

Duppies
Depressed urban professionals; former white-collar workers who are now unemployed or working for minimum wage.

Up-Res
Using imaging software to improve the quality of low-resolution digital pictures.

Metrodox
Adjective for young, cosmopolitan, orthodox Jews who want to balance hipness and religion – that whole mishegas.

Drug Deals
Military slang for backroom favors soldiers do for each other, like what Radar used to work out with Sparky on *M*A*S*H*. Popular way to get water in Iraq.

Social Fisking
The blogger practice of picking apart a quote or excerpt by hotlinking to online forums. Derived from Robert Fisk, whose antiwar writing was attacked by prowar bloggers.

– **Gareth Branwyn**
(jargon@wiredmag.com)

Thanks to contributors Kevin Kelly and Paul McFedries

This is not a drill. A recent study identified financial statistics, R&D data, strategic plans and customer lists as the top information items stolen from companies. Why? Because the more this information empowers you, the more valuable it becomes. Unprotected, it makes a juicy target. But even random attacks can cost you. The Radicati Group says malicious code will cause over $57B in economic damage by 2006. The answer? Security solutions that work inside, outside and end to end.

"Can I see some ID please?"

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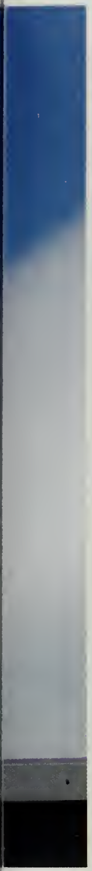

A guide to the on demand world: **Security**

How to tell anyone anything without telling everyone everything.

It's a tightrope. And as an on demand business, you're walking it. On one hand you need to be responsive, flexible and welcoming. On the other you need to protect the vital data that makes such flexibility and responsiveness possible. Accessible and user-friendly, but still secure. Open to anyone. But not everyone.

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The Final Frontier

As graveyards go, an aircraft could do a lot worse. The new branch of the Smithsonian Institution's National Air and Space Museum is beautiful, spacious, and packed with distractions for visitors. The 760,000-square-foot center, located in northern Virginia at Washington Dulles Airport, will eventually house hundreds of retired craft such as the *Enola Gay* B-29 Superfortress and the shuttle *Enterprise*. Many are suspended from the rafters of the main hangar like model airplanes in an adolescent's bedroom. There's also an IMAX theater, the Mobile Quarantine Facility – constructed in case Apollo astronauts brought moon germs back home – and a 164-foot observation tower with a mock air-traffic control center. Congress balked at the facility's $311 million price tag, so the museum relied almost entirely on private funds. Aviation entrepreneur Steven F. Udvar-Hazy, who made his money as the founder of International Lease Finance, won naming rights with a $65 million donation. – **Thomas Hayden**

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POLLUTION

Where CO_2 Goes to Die

It sounds like an environmentalist's dream: technology that can trap greenhouse gas before it harms the atmosphere. But the technique – carbon sequestration – is the darling of the Bush administration and Big Oil. So how green is it to store CO_2 in oceans, forests, coal deposits, and rock formations? Here's a rundown of four methods. – **Matthew Yeomans**

1 SALINE AQUIFERS

TECHNOLOGY: CO_2 captured from coal-fired power plants is injected into saline wells. The depth of these aquifers provides enough pressure to keep the CO_2 in liquid form, and the reservoirs are permanently isolated under dense, impenetrable rock.
POTENTIAL STORAGE: 500 billion tons in the US
BACKED BY: Electricity producers
WHERE: In New Haven, West Virginia, energy innovator Battelle is experimenting with storing CO_2 produced by an American Electric Power plant.
PROS AND CONS: Reduces emissions but promotes fossil fuel power plants – leading to more emissions.
GREEN FACTOR: Moderate

2 DEEP COAL SEAMS

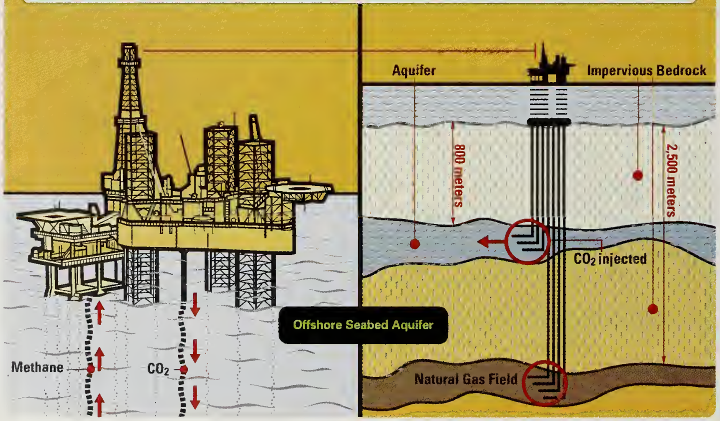
TECHNOLOGY: CO_2 is shot as deep as 4,500 feet into unminable coal beds, where it is quickly absorbed. Added bonus: The CO_2 displaces methane, which can be burned as fuel.
POTENTIAL STORAGE: The US sits on an estimated 4 trillion tons of coal, 90 percent of it unminable due to seam thickness and depth. Worldwide, such beds could sequester 150 billion tons of CO_2.
BACKED BY: Coal industry and power producers
WHERE: New Mexico's San Juan Basin
PROS AND CONS: Encourages the use of cleaner-burning natural gas, but also increases the production of coal, one of the most polluting fossil fuels.
GREEN FACTOR: Moderate

3 OFFSHORE SEABED AQUIFERS

TECHNOLOGY: CO_2 is injected into natural undersea saline aquifers thousands of feet below the surface. An impervious bed of rock seals the CO_2 inside.
POTENTIAL STORAGE: Unknown, but could exceed all land-based storage methods
BACKED BY: Oil companies with offshore rigs
WHERE: Norway. Statoil deposits about 1 million tons of recovered CO_2 annually into the Utsira Sand, a saline formation below the North Sea floor.
PROS AND CONS: A convenient way to store CO_2 emissions from offshore drilling, but nobody knows the impact on sea life if the CO_2 escapes.
GREEN FACTOR: Low

4 FORESTS

TECHNOLOGY: Plant a tree. New forests increase the absorption of CO_2 through photosynthesis.
POTENTIAL STORAGE: Over 40 years, an acre of additional forest removes 150 to 200 tons of CO_2.
BACKED BY: Environmentalists and the energy industry, which gets good PR for enviro-friendliness
WHERE: The US has hundreds of forest-based projects; other major efforts are under way in Costa Rica and Indonesia.
PROS AND CONS: Preserves the environment, but some scientists worry that CO_2 storage in forests isn't fail-safe. Trees die.
GREEN FACTOR: High



He's history: Oracle's general heads for trouble.

TYCOONS

Larry Ellison's Waterloo

Larry Ellison is obsessed with buying PeopleSoft. Can you say quagmire? Sure, his Oracle empire is awesome – $9 billion in annual sales and 40,000 employees. But we can't shake the feeling that the chief egotistical officer is headed for a great fall. The signs:
Scut Farkas Phenomenon Scut was the green-toothed bully in *A Christmas Story*. His reign of terror ended when Ralphie finally beat the crap out of him. When it was PeopleSoft's turn to stand up, the management, employees, and even customers mounted a gutsy counterattack. Now Ellison looks weak and desperate – two things a bully should never be.
Dinosaur Syndrome High tech has always flip-flopped between large, centralized IT and small, personalized computing. Companies like Oracle that make it big during centralizing eras often die in the phase change.
Zeitgeist Sync Failure Ominous glass towers, mercurial product releases, pushy salespeople – Oracle's business style was out-of-date *before* the dot-com boom. Let the brain drain begin.
Grandpa Effect Ellison is dissing the Valley's prospects even as a revival takes hold. Red flag. Entrepreneurs who spew only gloom are usually talking about their own faded glory.
Rat Pack Redux When America was going psychedelic, Frank, Sammy, and Dino were predicting rock and roll's demise. Sound familiar? Ellison is out of touch. Does he really believe that fast cars, women, Migs, and yachts make him look cool ... instead of just creepy? – **Michael S. Malone**

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How to Keep Your Number Forever

Switch cell carriers as often as you'd like, without changing coordinates

This year, the holidays could mark the end of millions of relationships – between individuals and their cell phone companies. As of November 24, after years of delay, new FCC rules require telcos to let customers keep their mobile numbers when they switch wireless providers. Local telephone number portability is a fundamental change in the cell phone business. Customers can chase lower rates and better service without reprinting business cards or sending yet another "change of coordinates" email. Get ready to hop promiscuously from carrier to carrier and still maintain a committed relationship with 10 little digits. Number portability means never having to say you're sorry.

THE BACKSTORY: Congress first raised the notion of number portability – for landlines – while debating the 1996 Telecommunications Act. Soon after, the FCC thought it might spur competition in the wireless industry. Lobbyists fought it, arguing that rivalry among firms was already strong – 30 percent of mobile phone customers jump carriers annually and, they said, service plan pricing declined 80 percent in the previous eight years. After endless squabbling and a few rounds in court, the industry lost and has since spent months scrambling to upgrade systems and to train workers – at a cost upwards of $1 billion.

THE TECH: The trick is handing off the administration of specific numbers from one carrier to another. Each cell phone handset transmits a signal that identifies it to nearby antennas: "I respond to *this* number, and I belong to *this* network." Farther up the org chart, the companies' computers figure out whom to bill when a particular number shows activity. For a number to port, your new phone has to be encoded with the old number but self-identify as part of a different network. At least, that's the theory. As of October, none of the carriers had run a joint test. Some were predicting technological hiccups – long hold times for customer service, calls that won't connect, billing errors, and the like. But since most carriers have resisted portability from the start (Verizon dropped its opposition this summer), their worries are somewhat suspect.

THE OUTCOME: As many as 8.7 million of the country's 149 million cell customers may switch carriers immediately – like, finger-poised-over-redial immediately. Some analysts speculate that in the months after the shift, the industry's churn rate might spike to 50 percent. In the long term, business customers – 40 percent of the total base – may be more likely to play the field, especially if they believe changing carriers will result in fewer dropped calls and less static. On the industry side, wireless firms won't reveal their marketing plans, but expect some desperation in the face of all these potential defections ("Can you hear me now? Please?"). A price war like the long-distance battle of the 1990s is possible, but companies might just hold prices steady – instead rolling out offers for, say, a free month of service or a new phone in return for signing a long-term contract. Even with portable numbers, a contract is still a contract and, as the saying goes, early termination fees will apply.

THE FUTURE: While it's unlikely that newborns will be issued mobile numbers along with their Social Security cards, someday you could have a single number that follows you for a lifetime. Meanwhile, expect more wireline-to-wireless transfers, "cutting the cord" on landlines – because number portability is supposed to cover those switcheroos (and vice versa), too. Years from now, you might remember that phone plugged into the wall with the fondness reserved for your first love – the one you eventually dumped. **– Daniel McGinn**

NOTHING MEDIALAB

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HYBRID
SYNERGY
DRIVE

TODAY TOMORROW TOYOTA

SOFTWARE

Gaming's Global Hot Spots

Who needs Hollywood? When it comes to luring a hot industry, nations around the world are racing to set up videogaming centers. It makes economic sense: Last year the burgeoning button-mashing biz raked in $30 billion worldwide – movie studios, meanwhile, grossed a mere $19 billion at the box office. We toured some of the hot spots vying for birth rights to the next *Mario* or *Grand Theft Auto*. – **John Gaudiosi**

MARSEILLES, FRANCE

THE PLAYERS: Action Synthèse, Light and Shadow Productions, and Mind2Machine are among the first studios to take advantage of the region's $3.5 billion bid to transform this port town into a technology center.

WHY HERE: The state-of-the-art Belle de Mai Media Center is leasing 300,000 square feet of space to gaming, high tech, and broadcast media companies. And with 11 IT training schools, plus one dedicated to gaming and CG filmmaking, there's plenty of homegrown talent.

HOT EXPORT: Action Synthèse is creating France's most expensive CG movie, the $20 million *The Magic Roundabout*, which hits theaters in 2004. Light and Shadow has *Sitting Ducks* and *Dead to Rights*.

MONTREAL, QUEBEC

THE PLAYERS: Ubi Soft's largest facility is in this bilingual city, and Electronic Arts is building a big studio. A2M, Microids, and Strategy First hang out shingles here, too.

WHY HERE: Tax breaks, a weak Canadian dollar, and a big-city feel at a fraction of the cost. And the local universities are turning out game programmers *très rapidement*. For Ubi Soft, the fact that graduates speak French is a bonus.

HOT EXPORT: Last year, Ubi unleashed *Tom Clancy's Splinter Cell*, which one-upped *Metal Gear Solid 2*. In November, the hero from *Prince of Persia* returns in *The Sands of Time*, another surefire hit for the studio.

MELBOURNE, AUSTRALIA

THE PLAYERS: Ten game outfits, including Atari, Infinite Interactive, and THQ, have set up shop in and around this coastal city.

WHY HERE: When not staring at a PC screen, programmers can surf, fish, or frolic on the sandy beaches. What's more, the local government is giving away PlayStation 2 developer kits, and the US dollar goes a very long way down under.

HOT EXPORT: Atari's Melbourne House is working on the much-anticipated *Transformers: Armada* for PS2, due out in April. French developer Ubi Soft has teamed up with Infinite Interactive on *Warlords IV*.

SEOUL, SOUTH KOREA

THE PLAYERS: Thanks to the government-sponsored broadband rollout, most of this city's 10 million people have access to high-speed Net connections. The world's largest online-game company, NCsoft, has joined forces with Samsung to sell *Lineage*-branded gaming boxes at half price. Now 50 percent of its online subscriptions come from home accounts.

WHY HERE: South Korea boasts the largest broadband audience in the world, and dozens of Internet game companies have established a presence in Seoul. Koreans are addicted to online gaming.

HOT EXPORT: After five years of Net subscriptions, NCsoft's *Lineage* has gone 3-D with *Lineage II*, which should help this online giant break through stateside.

TV Sports on Fast-Forward

Why can't watching sports on TV be more, well, efficient? Ahmet Ekin says it can. The University of Rochester grad student wrote some clever software that recognizes and filters out the boring parts of a game. His Automatic Sports Video Analyzer stacks the action together at the bang-bang-bang pace of a highlight film, so a four-hour football matchup clocks in at about 60 minutes.

So far Ekin has tackled an app for football and soccer. He's negotiating with a Swiss company that plans to beam soccer and hockey highlights to cell phones during the 2004 Olympics, and TiVo users are a dream market. The software won't be out in time for January's Super Bowl, though. So if the game gets boring, you may need to reach for a low tech fix: the remote. – **Douglas McGray**

MARSEILLES: COREL; MONTREAL: DAVE G. HOUSER/CORBIS; MELBOURNE AND SEOUL: DIGITAL VISION

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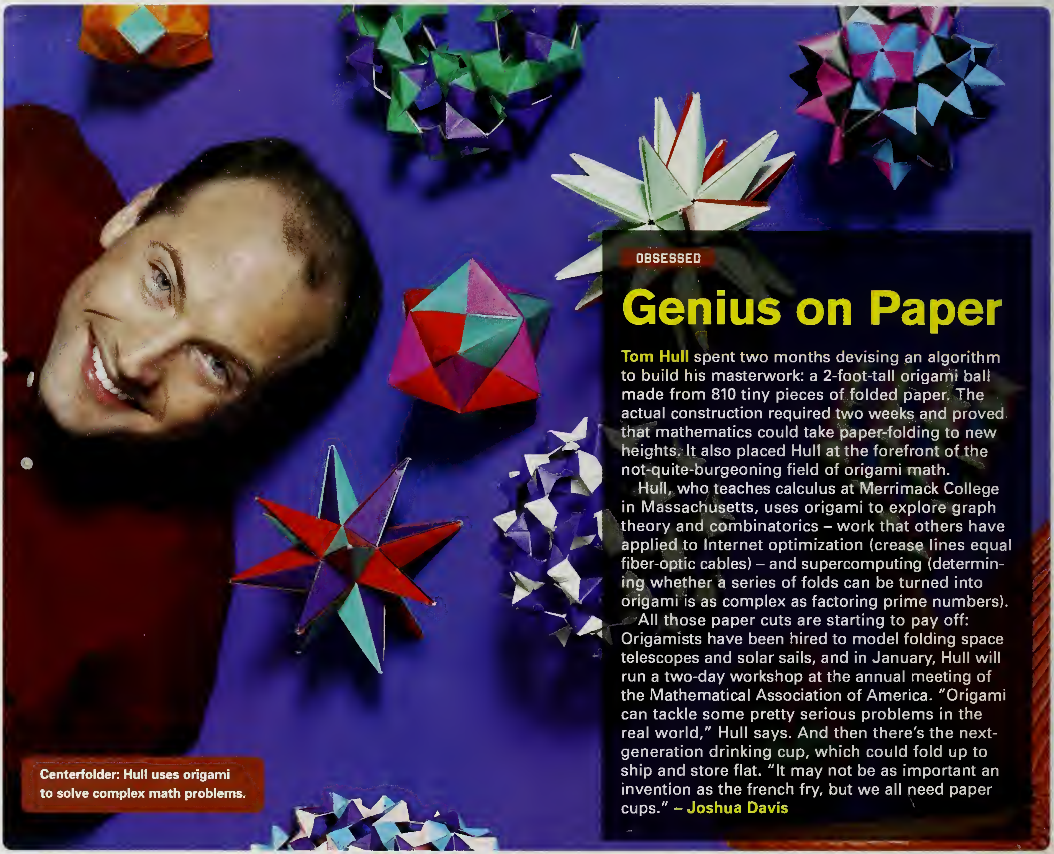


Centerfolder: Hull uses origami to solve complex math problems.

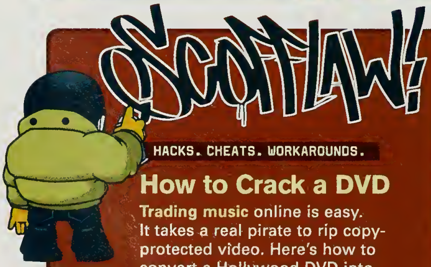
OBSESSED

Genius on Paper

Tom Hull spent two months devising an algorithm to build his masterwork: a 2-foot-tall origami ball made from 810 tiny pieces of folded paper. The actual construction required two weeks and proved that mathematics could take paper-folding to new heights. It also placed Hull at the forefront of the not-quite-burgeoning field of origami math.

Hull, who teaches calculus at Merrimack College in Massachusetts, uses origami to explore graph theory and combinatorics – work that others have applied to Internet optimization (crease lines equal fiber-optic cables) – and supercomputing (determining whether a series of folds can be turned into origami is as complex as factoring prime numbers).

All those paper cuts are starting to pay off: Origamists have been hired to model folding space telescopes and solar sails, and in January, Hull will run a two-day workshop at the annual meeting of the Mathematical Association of America. "Origami can tackle some pretty serious problems in the real world," Hull says. And then there's the next-generation drinking cup, which could fold up to ship and store flat. "It may not be as important an invention as the french fry, but we all need paper cups." – **Joshua Davis**



HACKS. CHEATS. WORKAROUNDS.

How to Crack a DVD

Trading music online is easy. It takes a real pirate to rip copy-protected video. Here's how to convert a Hollywood DVD into compressed DivX for playback, editing, or broadband trading via your PC. – **Brian Lam**

1 **GET SOFTWARE:** Google "rip DVD" and you'll turn up tons of underground freeware for decrypting, ripping, and encoding. The best: EasyDivX (see *easydivx.does.it*).

2 **RIP:** EasyDivX can now copy the unscrambled video object files onto your hard drive. Make sure you have at least 10 Gbytes available to temporarily store the raw video.

3 **DECRYPT:** To unscramble a DVD, play it on your PC. EasyDivX grabs the stream. (Our lawyers suggest talking to your lawyers first; you may be violating the Digital Millennium Copyright Act.)

4 **COMPRESS:** The software can boil a 9.4-gig feature-length flick down to a 700-Mbyte DivX file, which fits on a CD and is the video swapper's top choice.

HULL: JOEL BENJAMIN; SCOFFLAW: 123KLAN

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RESEARCH

The Stem Cell Refugee

Two and a half years ago, President Bush restricted federal funding for research that uses embryonic stem cells. So one of America's top scientists in the field, Roger Pederson, got the hell out of Dodge. He resigned from UC San Francisco and started the Cambridge Centre for Stem Cell Biology and Medicine at the University of Cambridge, in England. It was a controversial move in a controversial field; Pederson was the most senior scientist to relocate, responding to British promises of a welcoming environment, both in terms of funding and ethics rules. Now Pederson has the resources to continue his work – and to ask what our protean nature tells us about being human. **– Wendy Goldman Rohm**

Free at last: Former UCSF star Pederson set up shop in Britain.

GEMMA BOOTH

WIRED: How are things different in the UK?
PEDERSON: They haven't made such a political football out of stem cells. Animal research is more opposed than embryo research, and they're against genetically modified food. There were a couple of big policy debates following the birth of Louise Brown [the first IVF baby] that addressed a lot of these issues. I don't know what the opposition in the US means. It intrigues me that people who are opposed to embryo research by and large have no idea what an embryo is.

OK, but are you homesick?
I have a soft spot in my heart for America. But the UK is much better for this research. Here, there is government funding, and the funding goes where the science goes.

Are you actually cloning human embryos to derive stem cells?
No, no one in the UK has done that yet. You have to get a license. If there was a need, we would apply for one.

Supposedly, in China it's easier to get human eggs. Will they take the research lead?
The UK has more working capital, so I don't know. The silicon revolution happened in California; the stem cell revolution could happen in Asia. Anyway, it's futile to do everything in one country. That's why I'm involved in a UK-led international standardization effort, the Human Stem Cell Project. The International Society for Stem Cell Research in the US is also taking a lead.

What are you working on right now?
At the center, we work on all areas of potential specialization of stem cells, including neuronal, pancreatic beta cells, blood, and, more recently, heart cell differentiation. When most cells specialize [replicate as a specific cell type], they become monolithic. They don't reverse themselves. The cell that can go back is the stem cell. Differentiation is the expression of a set of genes that connotes a particular cell type. But we don't know why that set of genes got expressed or what maintains their expression. We don't understand the condition of the chromosomes that precedes and maintains that specialized state.

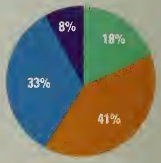
These cells seem pretty miraculous.
Most of our tissues that are in contact with the environment turn over rapidly. Your legacy isn't just your body but also large piles of cells produced because of this replacement phenomenon. It's what I call the tectonic human, like the tectonic Earth – constantly renewed from deep sources and melted back into magma again. Our body is always changing, we just don't see it.

wired	tired	expired
campuswide VoIP	campuswide Wi-Fi	campuswide T1
Battlestar Galactica	*Stargate SG-1*	*Enterprise*
Dell TV	Dell PC	Dell PDA
electrowet paper	electrophoretic ink	electronic books
iPod upgrade anxiety	cell phone upgrade anxiety	laptop upgrade anxiety
antispam lynch mobs	antispam legislation	antispam software

PULSE

Very Personal Computers

Researchers want to outfit PCs with personalities. (See "The Love Machine," page 230.) So someday you may download a change of attitude for your desktop as easily as a ring tone for your cell phone. Of 768 *Wired* readers polled, 41 percent prefer a no-frills affect. But don't count out KITT and C-3PO yet: 33 percent want a friend.



What kind of personality do you want in a computer?

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🟧 **A no-nonsense professional**
🟦 **A friendly confidant**
🟪 **A nonhuman cartoon**

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You're Being Watched

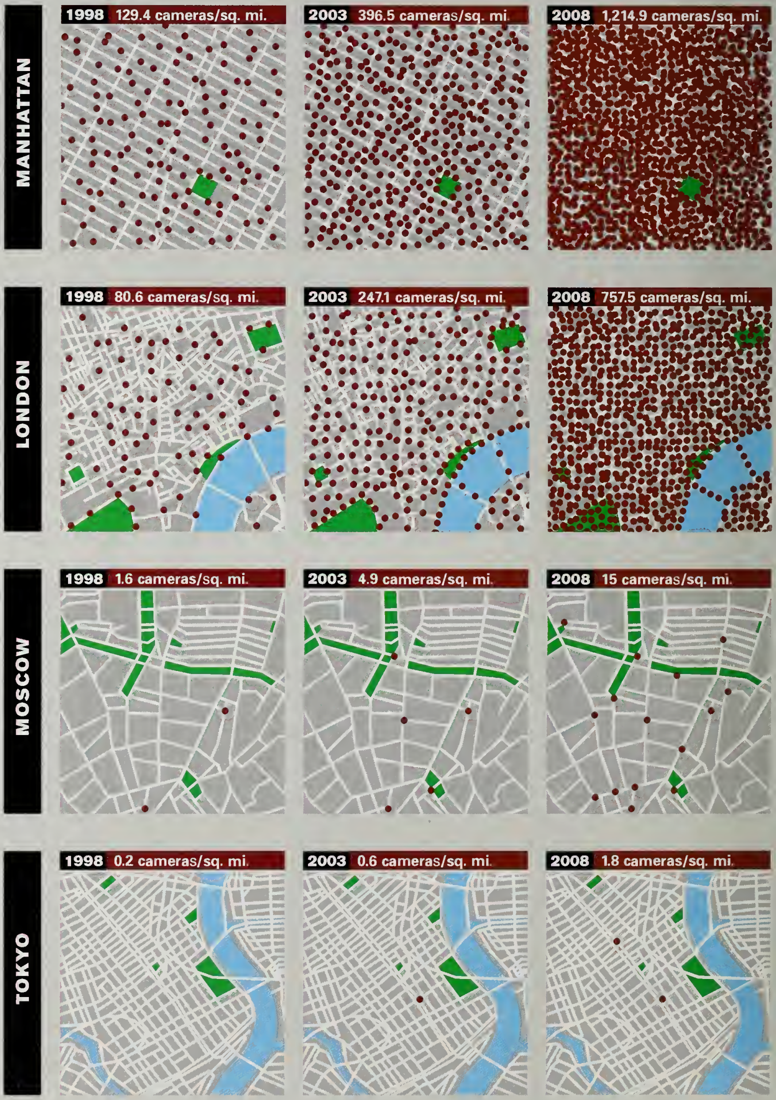
Keeping tabs on the private surveillance cams invading public spaces

Big Brother is a lot smaller than you think. Of the 9,000 surveillance cameras in Manhattan, only 5 percent are operated by public agencies. The rest are privately run. It's mostly storekeepers, building managers, and Internet users – not governments – that are watching you.

Why? Because they can. Private cams are subject to fewer restrictions and less oversight than public ones. Major casinos, for example, collect and share facial-recognition data to identify both cheaters and high rollers, allowing each to be greeted appropriately. Think that's scary? The Carnegie Mellon Data Privacy Lab estimates that footage from as many as 10,000 of the country's public-space cams ends up on the Web, meaning your mug could be viewed and stored by anyone, anywhere in the world. That might surprise the three out of four people in the US who tacitly endorse public surveillance.

Of course, the Feds aren't completely out of the loop. On top of their own operations, authorities can ask for – or subpoena – footage collected by others. Electronic eyes keep getting more sophisticated, too. The London Underground is testing software called the Intelligent Pedestrian Surveillance System that can predict and detect criminal or dangerous behavior, including suicide attempts.

If you really want to be paranoid, though, consider that there are roughly 30 million cell phone cameras and 25 million videocams in the world today. Fear your own brothers and sisters, not clueless old Uncle Sam.
– Patrick Di Justo



Sources: ACLU, Axis Communications, Lonely Planet, Moscow Telecommunication Corporation, New York Surveillance Camera Players, Transport for London. Growth rates extrapolated by *Wired* from prior growth figures.

Dots do not connote actual camera location.

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The Thin Science of Fad Diets

Wired rates the claims of trendy weight loss plans, from Atkins to South Beach

If more Americans liked math, the nation wouldn't be so fat. Virtually anyone's weight problem can be solved with this simple formula: Subtract 3,500 calories from your weekly diet, lose a pound every 7 days. Yet 125 million people can't seem to grasp the concept – or choose not to – and a $40 billion industry has emerged to help them.

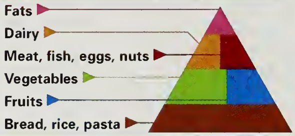
The most popular weight-loss programs are backed by celebrity doctors who promise lots of fringe benefits, such as lower cholesterol and increased energy. Health care professionals say scientific-sounding talk and small clinical trials have given fad diets staying power, yet there's no real proof that many of these plans are safe and effective over the long haul. So researchers like Christopher Gardner, director of nutrition studies at the Stanford Prevention Research Center, are conducting comprehensive studies of the leading diets, from Atkins to Weight Watchers; Gardner aims to publish a report by 2006 comparing four top programs. The National Institutes of Health is also funding a long-term examination of several leading diets, with results due in 2007.

Meanwhile, the federal government recently admitted that its Food Guide Pyramid – promoted as the safest, smartest diet for everyone – is woefully outdated. The pyramid, last revised in 1996, will be officially redrawn in 2005. Government health officials are openly discussing how it might look. In fact, a few preliminary sketches are already available. The feds say that one pyramid for the masses might no longer be the right approach, so they may hedge their bets with several variations. Here's a look at how a leading contender, designed by Harvard profs, and a few of the fad alternatives rate. **– Tom Stein**

HOW THE DIETS STACK UP

Wired's rankings are based on input from diet experts at the Harvard School of Public Health, the Stanford Prevention Research Center, the American Institute of Cancer Research, and the American Dietetic Association. Each plan is scored on a scale of 1 to 10 (the more points, the better) for calorie allowance, health benefits, safety, patients' ability to maintain weight loss, stick-to-itiveness, and support for the diet within the scientific community.

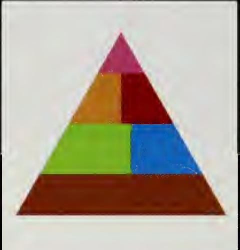
FOOD GROUPS



TYPES OF SCORES

DCA	Daily calorie allowance
HLTH	Health benefits
SFTY	Safety
WT	Ability to maintain weight loss
EZ	Easy to follow
SCI	Support within scientific community
BL	Bottom line

USDA FOOD PYRAMID



DCA **2,200** (men, active women)

HLTH	SFTY	WT	EZ	SCI	BL
8	7	8	8	7	8

THE PLAN: For eight years, the official USDA pyramid has called for eating a variety of foods from the five major food groups (and a little fat) to get the nutrients you need and the right amount of calories to maintain optimal weight.

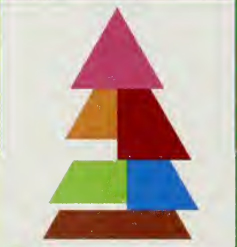
WEIGHT LOSS: Don't sweat it. If you're living by the pyramid, you should be just right.

POPULARITY: N/A

THE FACE BEHIND THE DIET: Uncle Sam

THE SKINNY: Inaccurate and outdated.[1]

HARVARD'S HEALTHY EATING PYRAMID



DCA **No recommendation**

HLTH	SFTY	WT	EZ	SCI	BL
9	8	9	8	9	9

THE PLAN: Harvard professors tweak the government's pyramid to stress vegetable oils, produce, and whole grains. Refined grains, dairy, and red meat are lower priority, and nuts and legumes receive their own category (not shown).

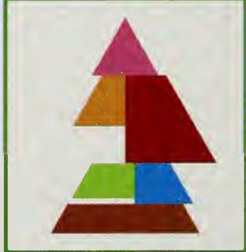
WEIGHT LOSS: 25 people lost an average 15 pounds over 6 months

POPULARITY: 100,000 books sold

THE FACES BEHIND THE DIET: Meir Stampfer and Walter Willett, who teach epidemiology and nutrition at the Harvard School of Public Health

THE SKINNY: A more accurate, up-to-date alternative to the USDA Food Pyramid.[1]

MEDITERRANEAN DIET



DCA **2,200**

HLTH	SFTY	WT	EZ	SCI	BL
9	8	8	8	9	8

THE PLAN: For Greeks it's a lifestyle, but for more and more Americans, it's a weight loss diet. It champions disease-fighting edibles (fiber and calcium) and healthier kinds of fats (some call it the Olive Oil Diet). But followers must watch portion sizes.

WEIGHT LOSS: 6.6 pounds over 3 months (based on 56 dieters)

POPULARITY: 55,000 books sold

THE FACES BEHIND THE DIET: People in Greece, southern Italy, and parts of Spain, Portugal, and France

THE SKINNY: A Mediterranean diet makes for a lower risk of death from heart disease and cancer.[1]

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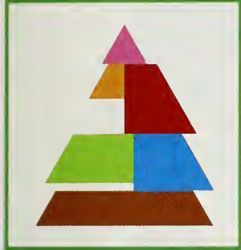
1. Clinical trial published in peer-reviewed journal; 2. Not published in a peer-reviewed journal; 3. Backer's claim

EAT MORE, WEIGH LESS



DCA No limit

HLTH	SFTY	WT	EZ	SCI	BL
8	8	7	8	8	8

THE PLAN: This low-fat, vegetarian approach doesn't suggest reducing your intake; instead, it emphasizes improving the quality of what you eat. The diet is low in fat and high in complex carbs.

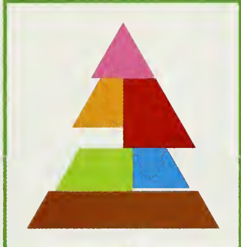
WEIGHT LOSS: 22 pounds the first year (based on 41 dieters)

POPULARITY: 1.2 million books sold

THE FACE BEHIND THE DIET: Dr. Dean Ornish, founder of the Preventive Medicine Research Institute and professor of medicine at UC San Francisco

THE SKINNY: Effective for weight loss but doesn't make room for "good" fats, such as monounsaturated fats.[1]

WEIGHT WATCHERS



DCA 1,200 to 1,900

HLTH	SFTY	WT	EZ	SCI	BL
8	8	7	7	8	8

THE PLAN: This 40-year-old program assigns all foods a point value based on calorie, fat, and fiber content. Foods are chosen with the goal of remaining within a daily points range in order to lose weight.

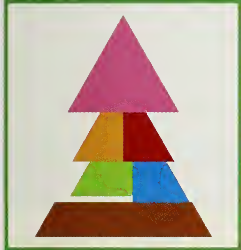
WEIGHT LOSS: 9.5 pounds over a 1-year period (based on 150 dieters)

POPULARITY: 25 million members

THE FACES BEHIND THE DIET: Founder Jean Nidetch and spokesperson Sarah Ferguson (aka Fergie, the Duchess of York)

THE SKINNY: Considered a nutritionally balanced weight loss diet, though the points system can be manipulated to favor junk foods.[1]

PEANUT BUTTER DIET



DCA 1,500 (women); 2,200 (men)

HLTH	SFTY	WT	EZ	SCI	BL
7	8	8	7	7	7

THE PLAN: On this high-fat diet, people eat 2 to 3 tablespoons of peanut butter twice a day, covering roughly 500 calories of a 1,500-calorie-a-day eating plan.

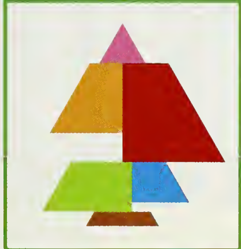
WEIGHT LOSS: 11 pounds over 6 months (based on 50 dieters)

POPULARITY: 200,000 books sold

THE FACE BEHIND THE DIET: Holly McCord, nutrition editor at *Prevention* magazine

THE SKINNY: Peanut butter contains healthy plant protein and some fiber, and is also cholesterol-free. It may even decrease the incidence of type 2 diabetes.[1]

SOUTH BEACH DIET



DCA 1,200 to 1,400

HLTH	SFTY	WT	EZ	SCI	BL
6	7	6	7	6	6

THE PLAN: A three-phase plan that cuts out most carbs in the first two weeks, then reintroduces so-called healthy carbs and low-fat dairy.

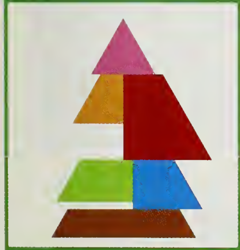
WEIGHT LOSS: 13.6 pounds in 12 weeks (based on 40 dieters)

POPULARITY: 3 million books sold

THE FACE BEHIND THE DIET: Dr. Arthur Agatston, cardiologist and associate professor of medicine at the University of Miami School of Medicine

THE SKINNY: Phase 1 involves potentially dangerous accelerated weight loss. But the diet can help people shed pounds and lower their blood pressure, cholesterol, and risk of heart attack and cancer.[2]

EAT RIGHT 4 YOUR TYPE



DCA 1,625 (type O)

HLTH	SFTY	WT	EZ	SCI	BL
6	6	7	7	5	6

THE PLAN: Everyone should eat foods that agree with their blood type in order to improve overall health and reduce risk of disease. For instance, people with type O blood were historically hunters and should eat more meats, while those with type A blood led a more agrarian lifestyle and should eat a vegetarian diet.

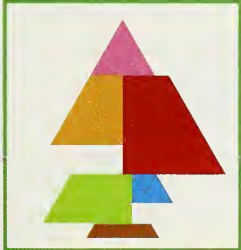
WEIGHT LOSS: 6 pounds in 2 weeks (based on 4 dieters)

POPULARITY: 3 million books sold

THE FACE BEHIND THE DIET: Dr. Peter D'Adamo

THE SKINNY: No scientific evidence suggests that the diet helps with weight loss or disease prevention.[3]

ATKINS FOR LIFE



DCA 1,500

HLTH	SFTY	WT	EZ	SCI	BL
6	5	6	5	5	5

THE PLAN: The bacon lover's diet, this much-maligned but wildly popular fad eliminates nearly all carbs.

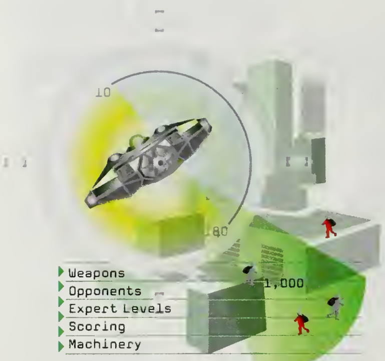
WEIGHT LOSS: 9.7 pounds in 12 months (based on 63 obese dieters)

POPULARITY: 15 million books sold

THE FACE BEHIND THE DIET: The late Dr. Robert Atkins, named one of *People* magazine's 25 Most Intriguing People in 1999

THE SKINNY: Violates all of the Food and Nutrition Science Alliance's 10 Red Flags of Junk Science; because it's high in fat, can be linked with heart disease and certain kinds of cancer.[1]

Sources: American Dietetic Association, American Institute for Cancer Research, *Journal of the American Medical Association*, Physicians Committee for Responsible Medicine, US Department of Agriculture, US Department of Health and Human Services



GAME ON

To think of video games as *just games* is to minimize the experience. The medium at its best has always been about creating immersive alternative realities — space adventures, medieval fantasies, even home-brewed interactive soap operas. And when a video game is that great, it's better than a movie, because the experience isn't passive or limited to just a couple of hours.

This past year has seen a new flowering of games as a unique art form. Developers are increasingly delivering incredibly realistic, deep, fully fleshed-out experiences with complex and often branching storylines or rich contexts for interaction with others. Credit advancing technology on the personal computer, as well as developers' increasing proficiency on the fixed platforms that are the major game consoles (which, in a new twist, are now becoming gateways to virtual worlds online). Most of all, the games' amazing new depth is the result of an industry rising to a higher level of storytelling in its many dimensions.

Playing today's A-list games requires a brawny PC or a so-called next-generation game console. Beyond those basics, there's a huge array of

Unreal® _Tournament 2004_ is the latest edition of the award-winning virtual blood sport, coming to personal computers this fall. A leader in the First Person Shooter category, _Unreal Tournament_ has been around since 1999 and has redefined what to expect in terms of graphics and gameplay with each upgrade.

If you imagine bloody gladiatorial combat moved to the far future, you've pretty much got _Unreal Tournament 2004_. Playing offline against artificially intelligent "bots," or online against other gamers, there's an incredible variety of ways to take out the enemy, from the infamous "headshot" to the all-new "road kill!" This time around, the developers – North Carolina's _Epic Games_ – have added a ton of new arenas, weapons, and, for the first time, vehicles. You'll be able to roar into combat in a tank or dive into the bowels of an enemy mother ship in your space-fighter, adding a new dimension to the classic, brutal, and, above all, fun gameplay. The game's publishers, Atari, are keen to point out that if you already have last year's _Unreal Tournament 2003_, you qualify for a $10 rebate, making the standard version of the game $29.95 (SRP $39.95) and the collector's DVD edition $49.95 (SRP $59.95).

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Unreal Tournament 2004

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2004 MANTA

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GAME ON

peripherals, such as the Pelican System Selector Pro, available at Best Buy. It's a nerve center for your gaming-oriented home entertainment system, letting you hook in up to eight audio-video inputs and eight components, not to mention three Ethernet connections. And if — heaven forbid — cheats are a key part of your console-gaming experience, you can get your hands on Datel's Action Replay Max, which hooks up to Sony's PlayStation 2 with an entire cheat-code library, with new ones acquired online via broadband connection. “Gaming keeps getting better all the time because of new technology and accessories that make gaming more exciting and easier to play,” said Lisa Hancock, Best Buy's business team leader for video games.

Once your tech needs have been squared away, you might be looking for a game that satisfies the most primal of urges — to compete and win in arena combat. Enter the world of Atari's *Unreal Tournament 2004* for the PC. The goal: to compete against other players online and computer opponents on futuristic battlefields to become the galaxy's best fighter. At your disposal is an awesome array of weapons and land and air vehicles. You can tune up by playing in single-player mode against computer opponents.

Video gamers, want to stay one step ahead of the game? Get into Best Buy and get the edge with all the latest and greatest games and accessories. Whether it's PS2, Xbox™, GameCube™ or PC, we've got you covered.

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Want to spend more time playing and less time entering codes? With a broadband connection, Datel Action Replay Max for PlayStation®2 lets you download their entire code library with the press of a single button. Datel's Action Replay Max also lets you avoid code collisions and lockups with Intelligent Codes, and features Auto Detect and updated graphics. Need more code storage space on your PS2 memory card? No problem. Action Replay Max lets you crush infrequently used saves and expand them again at any time.

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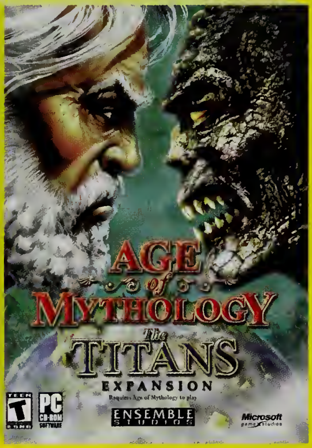
"The *Unreal* community is a huge part of advancing the franchise," said Steve Allison, Atari's vice president of marketing. The developer, Epic, "really recognizes the importance of growing their specific community of loyal players, and that's what drove the decision to make *Unreal Tournament 2004* fully compatible with *Unreal Tournament 2003.* Another great thing Epic is doing to foster community growth is sponsoring the "Make Something *Unreal* " contest with $1 million in prizes."

Some games don't look forward to the future but back to the past, or to legend. *Age of Mythology: The Titans Expansion*, from Microsoft Game Studios, builds upon last year's best-selling title. The idea behind *Age of Mythology* — descended from the *Age of Empires* series — is to build a civilization and battle rival civilizations, with some heavenly help from gods plucked from Greek, Egyptian, and Norse mythology. *The Titans Expansion* adds to that mix the mythology of the lost civilization of Atlantis, which can call down the might of Titans such as Cronus and Atlas.

Ian Fischer, *Age of Mythology*'s lead designer, noted that players increasingly are driving the process through which worlds are created for them. "After *Age of Empires*, we got a lot of requests for a 'sandbox' version of the game where players could send villagers out to plant farms or build homes without being attacked by an enemy," Fischer said. "There was a segment of our audience that was upset at

***Age of Mythology: The Titans Expansion*™ adds a fourth mythology, the Atlanteans, to the existing Greek, Egyptian, and Norse mythologies. A new single-player campaign will add yet another chapter to the franchise's expansive folklore along with the addition of new scenarios. Atlantean players will be able to call upon the might of the Titan gods (such as Atlas and Kronos) multiple times throughout the game, and may also upgrade human units to heroes. The expansion pack will introduce 12 new god powers, 15 new human units and 10 formidable myth units to the game.**

AGE of MYTHOLOGY
The TITANS
EXPANSION



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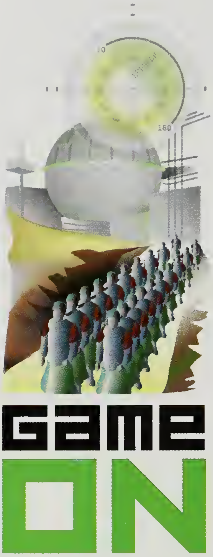


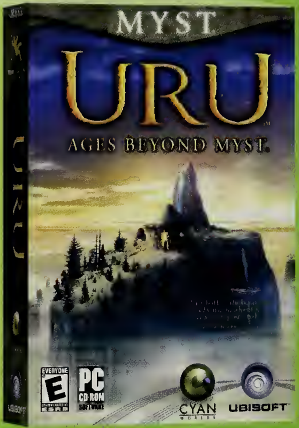
seeing their villagers killed, and they didn't like having to attack other villagers to protect them. This signals a massive shift in how people view games — nobody ever asked for a version of Pac Man without ghosts."

Sometimes the worlds of video games become legendary themselves. In the 1990s, the games *Myst* and *Riven* brought to life the land of D'ni for adventures of exploration and puzzle-solving. The two runaway best-sellers helped open the world of interactive entertainment to a broad audience — particularly women — that previously hadn't experienced the medium. The forthcoming *Uru: Ages Beyond Myst* from Ubisoft for the PC brings players back to D'ni — and this time, it's fully explorable in real-time 3D. Players create customizable avatars. In the single-player experience, they rove a number of ages in discovering the history of the lost D'ni civilization. A service called *Uru Live* will bring the experience alive online.

"The concept of *Uru* is to do what we've always done, but do it better," said Rand Miller, CEO of Cyan Worlds, which created *Myst* and *Riven* and is developing *Uru* for Ubisoft. "All we've ever wanted to do is make more immersive worlds, make places that are interesting to explore, and *Uru* is the next revolutionary step."

Deeper Than Time Itself . . . *Uru™ Ages Beyond Myst®*

From Cyan Worlds, the makers of *Myst®* and *Riven™*, comes *Uru: Ages Beyond Myst. Uru™* is the biggest, deepest, most immersive *Myst®* adventure yet. This groundbreaking adventure will challenge players to solve mind-bending puzzles and explore stunning 3D environments in a quest to uncover the mysteries of the lost D'ni™ civilization. Maintaining the gameplay that made *Myst®* so popular, the creators of *Uru™* have set out to reinvent the most captivating adventure game of all time. Secrets of the past must be uncovered. Secrets of the present must be understood. Secrets of the future must be revealed.



url uru.ubi.com

UBISOFT CYAN EVERYONE E CONTENT RATED BY ESRB

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From the original creators of Myst,® one of the best-selling PC games ever, comes the biggest, deepest, most challenging adventure yet.

Discover URU:™ Ages Beyond Myst.®

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Game ON

Online play is becoming essential to the gaming experience. Until recently, that's been the preserve of desktop computers. Now it's come to the gaming consoles with a vengeance.

Take *Counter-Strike*, published by Microsoft Game Studios for the Xbox console. It's a team-combat game best played online against other human players (a single-player mode pits players against computer AI opponents for practice). By most reckonings, *Counter-Strike* players on the PC log more time playing than those of any other similar online-game experience, period. The Xbox version will bring a number of new dimensions to the game, in which teams of players respectively take the role of terrorists and counter-terrorists. The graphics have been tuned up, and there are new maps on which to play. The Xbox *Live* online service through which players connect makes cheating far more difficult. John Dongelmans, Microsoft Game Studios' product manager for *Counter-Strike*, said the game includes support for Dolby 5.1 audio if an Xbox is hooked up to a home theater. "Sound is very important in *Counter-Strike* because you can hear people walking," Dongelmans said. "If you're playing the game with Dolby 5.1 hooked up, you can locate an enemy just by sound."

***Counter-Strike*™, the world's most popular online action game and first-person shooter for the PC makes its console debut exclusively on Xbox and Xbox *Live*. Challenge other players in intense team-based multiplayer action with up to 16 players in two thrilling game types (Bomb Defusal and Hostage Rescue) via Xbox *Live* or System Link. Get ready for the most graphically advanced version of the series to date: *Counter-Strike*™ for Xbox.**

COUNTER STRIKE™

url xbox.com/counterstrike

Counter-Strike™ and Xbox *Live*. A match made in "holy-*#!%-did-you-see-that" heaven.

MATURE 17+
M
CONTENT RATED BY ESRB
Blood
Intense Violence

Microsoft game studios

VALVE

Counter-Strike,™ the world's #1 online action game,* is even better on Xbox *Live*.™ With graphically superior action, 7 exclusive maps, up to 16 player game play and a vast arsenal of weapons, this is the best Counter-Strike yet. You may want to practice offline before you enter the merciless online arena. Here, you can go it alone or you can assemble an elite team of gamers and talk strategy over the *Live* Communicator on how to defuse bombs, rescue hostages and take on terrorists from all over the world. The competition will be tough, so you'd better come prepared.

XBOX LIVE

COUNTER-STRIKE™

XBOX

it's good to play together

xbox.com/counterstrike

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Game ON

An increasing number of games transport players to worlds first imagined on film. Certainly there's no such world more intriguing than that depicted in *The Matrix* movie trilogy. Atari's *Enter the Matrix*, available for the PC and the major game consoles, has been one of this year's biggest hits. The game puts a player in the roles of resistance fighters seeking to subvert the rule of the machines. Players engage in kung fu moves, defy gravity, go on wild car chases, and even pilot a hovercraft. And yes — there's bullet time.

"The Wachowski Brothers used the game as a vehicle to introduce players to a very important set of characters — Niobe and Ghost — who play a pivotal role in *Matrix Revolutions*, but had more minor roles in the onscreen story of *Matrix Reloaded,"* said Atari's Allison. "It was a visionary concept to shoot the exclusive content that made up Niobe and Ghost's journey along the timeline of *Matrix Reloaded* and introduce them to *Matrix* fans primarily in the game. If you've played *Enter the Matrix*, when you see *Revolutions*, you will know these characters very well — and you will know more about the *Matrix* universe and its meaning than a person sitting next to you in the theater who does not own the game."

A day will come when a new standard will be created to which all video games will be held accountable.

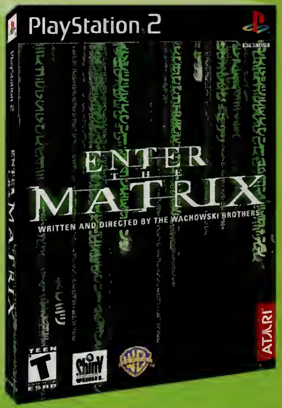
***Enter the Matrix*™ is the story-within-the-story. This game isn't just set in the *Matrix*™ universe – it's an integral part of the entire *Matrix* experience, weaving in and out of the highly anticipated second installment of the movie franchise, *The Matrix Reloaded*™.**

***Enter the Matrix* was developed under the creative direction of Matrix filmmakers Larry and Andy Wachowski. The unprecedented level of collaboration between Hollywood's hottest filmmakers and award-winning video game developers Shiny Entertainment promises to make *Enter the Matrix* a truly unique gaming experience.**

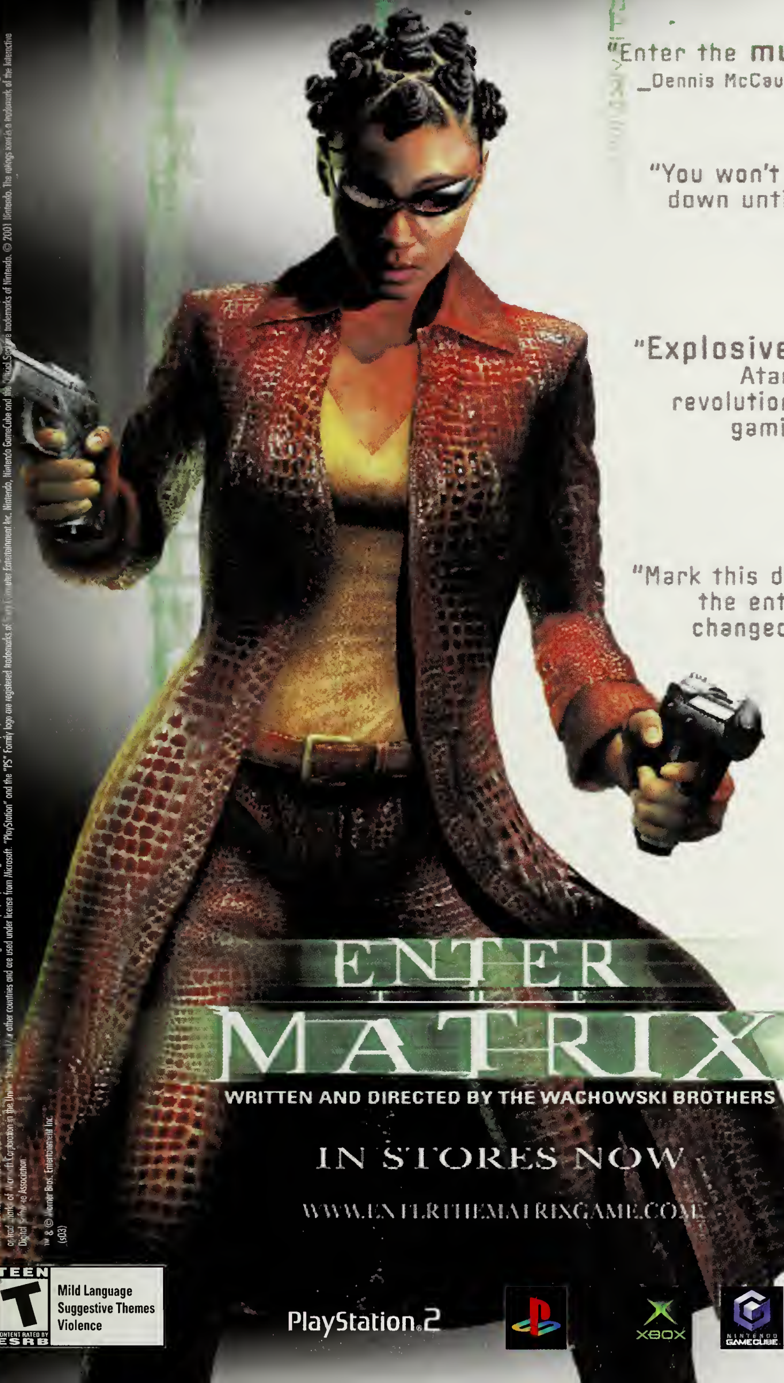
Featuring original action that both complements and intersects the elaborate *Matrix* storyline, *Enter the Matrix* provides renders taken directly from the movie sets. At times, players will actually see remnants of their gameplay surface in the film, *The Matrix Reloaded*™.

With previously unseen film footage and the most integrated entertainment experience to date, *Enter the Matrix* is a mind-bending tale of survival that redefines the relationship between Hollywood and video gaming.

url enterthematrixgame.com



ENTER THE MATRIX™



"Enter the **must-have** Matrix."
_Dennis McCauley, Philadelphia Inquirer

"You won't be able to put this down until you've seen all of the new footage."
_Game Informer

"Explosive and stunning– Atari's Enter the Matrix revolutionizes 3-D adventure gaming with blockbuster bravado."
_Nintendo Power

"Mark this down: this is the day the entertainment industry changed forever. **A-plus.**"
_Tribune Media Services

"Setting a new standard for game and movie studios working together."
_Detroit News

"...looks, smells, and feels like... The Matrix."
—Play

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(s03)

Now that you're overflowing with excitement about exploring all of these new worlds, go back for a minute to the technology that makes it all possible. This past year has seen the release of a number of new PC games that push hardware to the limit — offering in exchange beautifully flowing action and rich visuals with detailed environments and complex shadowing.

Computer makers are increasingly recognizing the need to make machines that are certifiably game-worthy. PC maker Alienware has long been ahead of that curve. Its Area-51 desktop computer combines sleek, futuristic industrial design with top-notch components. The new Area-51m laptop erases the traditional gap between mobile computers and their desktop counterparts, and even offers an upgradeable video chip. “An immersive gaming experience requires a PC designed to maximize the capabilities of the latest game technology,” said Brian Joyce, Alienware's director of marketing. “Alienware makes systems with state-of-the-art components, and geared for high performance to get the most from revolutionary developments in game graphics, sound design, and artificial intelligence.” ■

Alienware Corporation manufactures high-performance computer gaming desktop and mobile systems. Founded in 1996 with a motto of “build it as if it were your own,” Alienware is dedicated to providing customers with PCs that deliver an unrivaled gaming experience. Alienware offers unique and award-winning products that incorporate state-of-the-art technology, innovative design, and award-winning customer service to produce what industry reviewers have called the Ultimate Gaming Machines.

AREA-51 AND AURORA DESKTOP SYSTEMS

Alienware desktop systems deliver the ultimate in power, performance, and reliability with a truly unique style. Alienware gaming desktops are custom-built to meet the demanding requirements of current and future games, and can handle any application with ease, from home digital video editing and 3D animation to word processing.

AREA-51M MOBILE SYSTEMS

Alienware mobile systems take portable PC gaming to the next level with features like a user-upgradeable mobile video card, large crystal-clear display, outstanding storage capacity, and processors that deliver near-desktop performance. With a sleek magnesium alloy chassis, rubberized hand grips, and illuminated alien eyes, Alienware mobile systems have an aggressive style that matches their performance.

Alienware desktop and mobile systems are available direct within the United States and Europe. For more information, please call 1-800-ALIENWARE (254-3692).

url alienware.com

ALIENWARE

What Game Developers Think...

"Alienware systems deliver leading-edge performance." [Gabe Newell, Founder/Managing Director, Valve®]

What Reviewers Think...

"Alienware once again proves that it builds the game machines that dreams are made of."
[PC Gamer Editors' Choice award, one of ten in a row]

What Do You Think?

Visit www.alienware.com/playsbeston to compare the performance of your current system to an Alienware high-performance gaming system.

PLAYS BEST ON
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realtime

december

MON **TUE** **WED** **THU** **FRI** **SAT** **SUN**

1

SMALL WORLD
Sperm. CPUs. Rat brains. All look fab under a microscope. The NJ State Museum flaunts award-winning micrography.
microscopyu.com/smallworld/tours.html

2

PIRATES OF THE CARIBBEAN
Menacing undead buccaneers and a prancing Johnny Depp – on DVD! (And Kazaa, and Grokster, and ... curse those scurvy file-sharing dogs!)
pirates.movies.go.com

3

NYC TREE LIGHTING
Thirty thousand bulbs provide mood lighting for ice-skaters at Rockefeller Center until January 6 – or until the next power outage.
rockefellercenter.com

4

VIDEO GAME AWARDS
Spike TV hosts the first televised videogame award show. Acceptance speeches rock: "I'd like to thank Red Bull, the Playboy Channel, and Lara Croft."
spiketv.com

5

THE LAST SAMURAI
Box office returns for *Kill Bill* proved moviegoers want to see hot actors slash each other with swords. Tom Cruise gets in on the action today.
lastsamurai.com

6

A REALITY TOUR
The man who fell to Earth lands in Atlantic City to kick off his stateside shows.
davidbowie.com

8

CDMA AMERICAS CONGRESS
Pick up the 411 on E911 and other government mandates at this workshop in Miami.
iirusa.com/cdma_2003

10

AUSTRALIAN EFFECTS & ANIMATION FEST
ILM takes Neverland where it's never been before. Catch a sneak peek of the Lucas gang's live-action remake of *Peter Pan.*
dmw.com.au

12

DIGITAL VIDEO EXPO WEST
Follow Paul Marino inside a virtual 3-D world to find out how machinima movies get made.
dvexpo.com/west

13

RSA HOLIDAY ROBOT GAMES & EXPO
Discovery Channel's new ExploRobot and some 100 other droids invade San Francisco. Massive heavy metal battles ensue.
www.roboticssociety.org

16

NINJA GAIDEN
This fast-paced martial arts game for Xbox pits you against other black belts online. What's at stake: your life. Kick butt or die!
tecmoinc.com

18

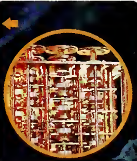
BIRTHDAY: STEVEN SPIELBERG
The T. rex of directors takes one step closer to Jurassic Park. Happy 57, Steve-o. And hurry up with *Indiana Jones 4!*

22

WINTER SOLSTICE
Enjoy the longest night by the light of the Ursid meteor shower at its peak.

26

BIRTHDAY: CHARLES BABBAGE
Calculate this: 2003 minus 1791 equals the age of the father of modern computing. No Difference Engine required.



28

108 YEARS AGO TODAY
The Lumière Brothers held the first movie premiere, screening 11 one-minute films at the Grand Café in Paris.

31

NEW YEAR'S EVE
Resolve to quit ripping DVDs, back up the home PC, and cut *EverQuest* play time to eight hours a day.

ROBOTICS SOCIETY OF AMERICA, SAMUEL M. CONIGLIO IV; COURTESY TECMO INC.; PAUL MARINO; NEWSCOM; GETTY IMAGES; COURTESY SONY; GETTY IMAGES

Burton's Big Adventure

The director speaks of freaks, f/x, and fantasy

Don't use the word *imagination* around director Tim Burton – it gives him the creeps. "It reminds me of when I was at Disney," he says. "They had this secret, CIA-like group who called themselves 'Imagineers.'" But Burton's films – *Beetlejuice*, *Edward Scissorhands*, *Mars Attacks!*, and *Sleepy Hollow* come quickest to mind – possess that trademark eccentricity clearly attributable to his overactive, um ... you know. His latest movie, *Big Fish*, out December 10 from Columbia Pictures, is no different. Burton weaves fantastic tales about a giant, a witch, and conjoined lounge singers into this Southern saga about a traveling salesman who's confronted by his estranged son. *Wired* caught up with the auteur just as *Big Fish* wrapped. **– Bill Desowitz**

WIRED: What drew you to this story?
BURTON: It touched on very real things in a very surreal way – the mixture of reality and unreality and how the two meet. Most people have a mother or a father, except for those of us who were reared by alien sea pods. You can't help bringing your own experiences into it, thinking how you relate to your own parents.

It's a kind of fairy tale, too, isn't it?
The movie has the classic symbolic imagery and mythology of fairy tales. But it's the juxtaposition of these things that it's got going for it.

Did you use effects to make the giant?
Only forced perspective [an optical illusion]. The effects are just matter-of-fact, as opposed to flashy. We didn't have a huge effects budget, so we did things like split-screen, smaller props, and lighting tricks.

Ewan McGregor said it was a relief to use a blue screen a lot less than he did in *Star Wars*.
Well, we threw in a couple of those just so he wouldn't get homesick. No, we relied on great actors to be as human with the screens as possible. We're dealing with *something* as opposed to *nothing*.

So do filmmakers overuse effects?
It's like anything. You can use it for good or evil. A few years ago they said, 'You're making a comedy: You don't need stereo.' The effects serve the story. It seems to work really well with animated films because it's consistent. But there's something about effects and live action. You look at an old James Bond movie and there's this visceral thrill about seeing somebody do their own stunt, whereas you lose something knowing that it was done in CG. Subconsciously, it affects what you see.

I've heard *Big Fish* referred to as your *Wizard of Oz*. Is it that surreal?
I don't know. I mean, how often have you seen something that nobody would believe if you told them about it? Then again, we see that kind of stuff all the time. What's real and what's not? One person's craziness is another person's reality. It's somewhat relative.

Do you do anything special to tap into the creative spirit?
You mean like communicating with a shrunken head or using a voodoo doll? I like to get in there and play around, but I have to be careful because I broke a rib on *Planet of the Apes*. I don't watch where I'm going, so I'm actually lucky to be alive. I get kind of hyper. The cameramen gave me a pedometer because I pace so much. In less than a month, I did 300 miles.

BURTON: RETNA

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The Wall of Fame

Meet the real star of *Lord of the Rings* – a 1,600-box server farm.

Gollum is real. So is Shelob. And Middle-earth did exist – just a long, long time ago. At least that's what Weta Digital, the visual effects house behind *The Lord of the Rings* trilogy, wants you to believe. Its mantra for the final installment: photorealism. *The Return of the King*, which opens in theaters December 17, will feature almost 50 percent more f/x shots than *The Two Towers* and will be composed of more data than the first two movies combined. Churning out scenes like the destruction of Barad-dûr and the Battle of Pelennor Fields (with thousands of bloodthirsty CG Orcs) took 3,200 processors running at teraflop speeds through 10-gig pipes – that's one epic renderwall. What else went into making Frodo's quest look so good? By Weta's account, more than you might think. – **Jennifer Hillner**

WETA BY THE NUMBERS

HUMANPOWER

IT staff: 35
Visual f/x staff: 420

HARDWARE

Equipment rooms: 5
Desktop computers: 600
Servers in renderwall: 1,600
Processors (total): 3,200
Processors added 10 weeks before movie wrapped: 1,000
Time it took to get additional processors up and running: 2 weeks
Network switches: 10
Speed of network: 10 gigabit (100 times faster than most)
Temperature of equipment rooms: 76 degrees Fahrenheit
Weight of air conditioners needed to maintain that temperature: 1/2 ton

STORAGE

Disk: 60 terabytes
Near online: 72 terabytes
Digital backup tape: 0.5 petabyte (equal to 50,000 DVDs)

OUTPUT

Number of f/x shots: 1,400
Minimum number of frames per shot: 240
Average time to render one frame: 2 hours
Longest time: 2 days
Total screen time of f/x shots: 2 hours
Total length of film: Rumored to be 3.5 hours
Production time: 9 months

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BAUER

A Kavalier & Clay Production

Holy modern metafictions, Batman! The superhero at the center of Michael Chabon's novel *The Amazing Adventures of Kavalier & Clay* is getting a real-life comic.

In the Pulitzer Prize-winning book, the title characters invent the Escapist, a combination Superman and Houdini who battles oppression and tyranny. Now other writers and artists are bringing Chabon's characters' character to life in a new quarterly series, *Michael Chabon Presents: The Amazing Adventures of the Escapist*. The first issue comes out December 17 from Dark Horse Comics.

The conceit behind the series is that the rights to Joe Kavalier and Sam Clay's creation have passed from company to company over the decades. So each 80-page installment will include stories about the Escapist imagined by different artists. "The only guideline," says Chabon, "is that the stories be in some way concerned with the theme of escape, however the artist chooses to define it."

The five stories in the first issue read like they came from the drawing board of the dynamic duo (especially Kavalier, who in the novel escaped 1930s Prague and poured his Jewish id into a funnybook hero, just like the creators of Superman). In the origin story, written by Chabon and drawn by Eric Wight, Max Mayflower presents his ward Tom with a golden key that gives him superpowers and the responsibility to fight the sinister Iron Chain organization. *American Flagg!* creator Howard Chaykin goes on to tell a noirish tale of Red Scare-era witch hunts. There's also a piece by writer Kevin McCarthy that explores the conflicted desires of Luna Moth, the character Kavalier modeled after his girlfriend.

For Chabon, who grew up "obsessed with comics" and then rediscovered them while doing research for *Kavalier & Clay*, seeing his creation come to life in "80 pulse-pounding pages" is a dream come true. "When they sent me the cover, I put it up on my fridge," he says. "I can't quite believe it." **– Robert Levine**

Advertisement

"I spent $2,342 on violent and suggestive video games."

Google & Co. to Hackers: Come On In!

Call it capitalist communitarianism: Some of the Net's biggest businesses have found a way to tap the open source model without giving away the store. The secret is a software protocol called an application program interface. An API is a published set of programming hooks that lets you interact directly with a company's open servers. In other words, you can mine company databases for free.

A new series by tech publisher O'Reilly explains how to use APIs to extract information from Amazon, eBay, and Google. The best part: There's no need to consult your Perl manual – these books offer dozens of handy scripts to automate tasks such as searching archives, product listings, and auctions in progress.

Exploiting APIs is not only legal, it's encouraged. True, many would say that letting users mine data is a bold step for a business to take: An API can attract more traffic to a Web site – and more traffic usually equals more revenue – but it carries the inherent risk you take any time you let strangers mess with your databases.

APIs remain a tough sell in many executive suites. Microsoft, which disclosed its Windows protocols only after being issued a court order, is said to be building an API for its online knowledge bases, with the hope of making it easy to find solutions to tasks without plowing through thousands of pages. But that's just a plan – it hasn't happened yet.

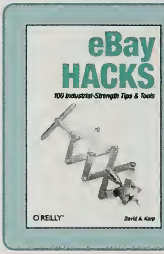
Still, if you've got the inclination – and enough skill to build a homepage – there's plenty out there for you to play with. **– Paul Boutin**

OUR DATABASE IS YOUR DATABASE

***Amazon Hacks: 100 Industrial-Strength Tips & Tools*, by Paul Bausch**

TIME-SAVER (PAGE 123): Ready to sell your old books? A simple script lists titles you purchased from Amazon that currently have buyers on the site's Marketplace.

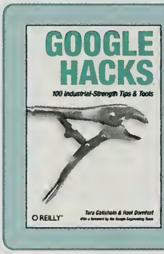
DIRTY TRICK (PAGE 126): Undercut the competition by gathering the highest, lowest, and average prices other sellers are charging.



***eBay Hacks: 100 Industrial-Strength Tips & Tools*, by David A. Karp**

TIME-SAVER (PAGE 32): Make shopping more efficient. With a single click, this code finds auctions similar to the one you're looking at.

DIRTY TRICK (PAGE 316): Boost your cred with a script that reciprocates positive ratings posted about you. It also tosses in a few words of praise, such as "Quick to pay, friendly emails."


GOOGLE HACKS
100 Industrial-Strength Tips & Tools
O'REILLY
Tara Calishain & Rael Dornfest

***Google Hacks: 100 Industrial-Strength Tips & Tools*, by Tara Calishain and Rael Dornfest**

TIME-SAVER (PAGE 284): Menu-planning made easy. Type in the contents of your refrigerator to find recipes online that match the ingredients.

DIRTY TRICK (PAGE 225): No need to actually read books. This script returns a list of the top 10 titles bloggers are linking to and relevant Google News stories.

READ ME

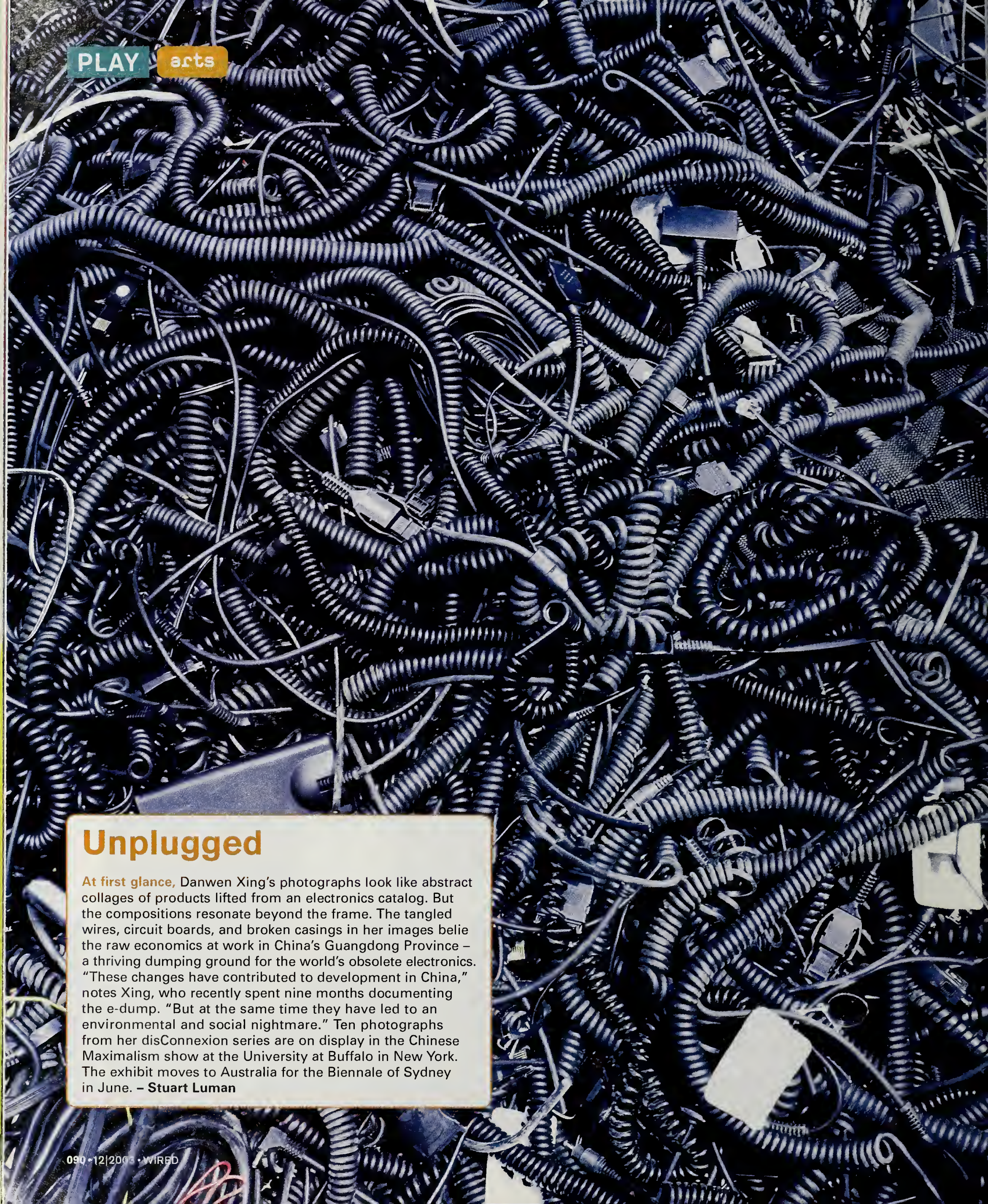
HALSEY MINOR

Founder of CNET Networks and CEO of Grand Central Communications

***The Travels of Marco Polo*, by Marco Polo**

"Marco Polo was the first person to chronicle the commercial and cultural challenges that existed during a period of very little international interaction. In many ways, modern corporations that want to collaborate at a technical level are like nation-states in the age of Marco Polo. Even when new technologies can be deployed to allow easier collaboration, the toughest barrier to homogeneity of any kind is culture. I founded Grand Central with the vision of creating a new model for companies to do business together – a model that would allow information to fluidly cross corporate borders despite the fact that each company developed its systems in isolation."

"I had $23,000 worth of liposuction."



Unplugged

At first glance, Danwen Xing's photographs look like abstract collages of products lifted from an electronics catalog. But the compositions resonate beyond the frame. The tangled wires, circuit boards, and broken casings in her images belie the raw economics at work in China's Guangdong Province – a thriving dumping ground for the world's obsolete electronics. "These changes have contributed to development in China," notes Xing, who recently spent nine months documenting the e-dump. "But at the same time they have led to an environmental and social nightmare." Ten photographs from her disConnexion series are on display in the Chinese Maximalism show at the University at Buffalo in New York. The exhibit moves to Australia for the Biennale of Sydney in June. – **Stuart Luman**

Advertisement

"There are 3 warrants for my arrest.
One of them involves smuggling."

New Gun in Town

What to expect from the sequel to *Deus Ex*

The world is what you make of it. Especially in *Deus Ex: Invisible War*, the long-awaited sequel to Warren Spector's smash first-person adventure game, due December 2 for PC and Xbox. The original *Deus* did away with linear play – the point-A-to-point-B flow that dominated gaming for years. *Invisible War* expands on that: You decide how to defeat terrorism and fight for a better tomorrow, as rival factions vie for dominance and your loyalty in 2072. Here's the skinny from Spector on how his new game outplays the old. – **Wagner James Au**

Warren Spector on ...

CHARACTER BUILDING

"We wanted players of all races and both genders to be able to relate to our central character," says Spector. To achieve this, his team built a tool that lets you tweak hero Alex D's look. And choice extends way beyond appearance. Augment Alex with combat, stealth, hacking, and diplomatic skills, or biomods from legitimate or black-market sources, refining your mix minute-by-minute as each new task demands.

PROBLEM SOLVING

Forget about following a script. The game's open-ended architecture offers many means to every end. To commandeer an airship, you can pay off the guard, blast the barricades to bits, or sneak in under cover of darkness without harming a soul. Each route has different consequences. According to Spector, "We force players to think about ethical and political issues without beating them over the head."

ADVANCED WEAPONRY

A beefed-up arsenal includes holsters of high tech gadgetry, like a nanotech sword and a camera-guided rocket launcher. But you can forgo firearms altogether and take the pacifist route. "There's always a stealth or conversation path past each obstacle," Spector says. "We have to provide game systems that allow nonviolent possibilities. But, man, it's hard work!"

MOTION GRAPHICS

The first *Deus Ex* skimped on graphics. Not so with *Invisible War*. "Our tech is pretty cool," says Spector, "with dynamic lighting, volumetric shadows, Havok-driven physics, and realistic sound propagation" that lets you hear noises through windows. The result is more realistic and immersive. Plus, the glossy look will definitely push the capacity of your graphics card.

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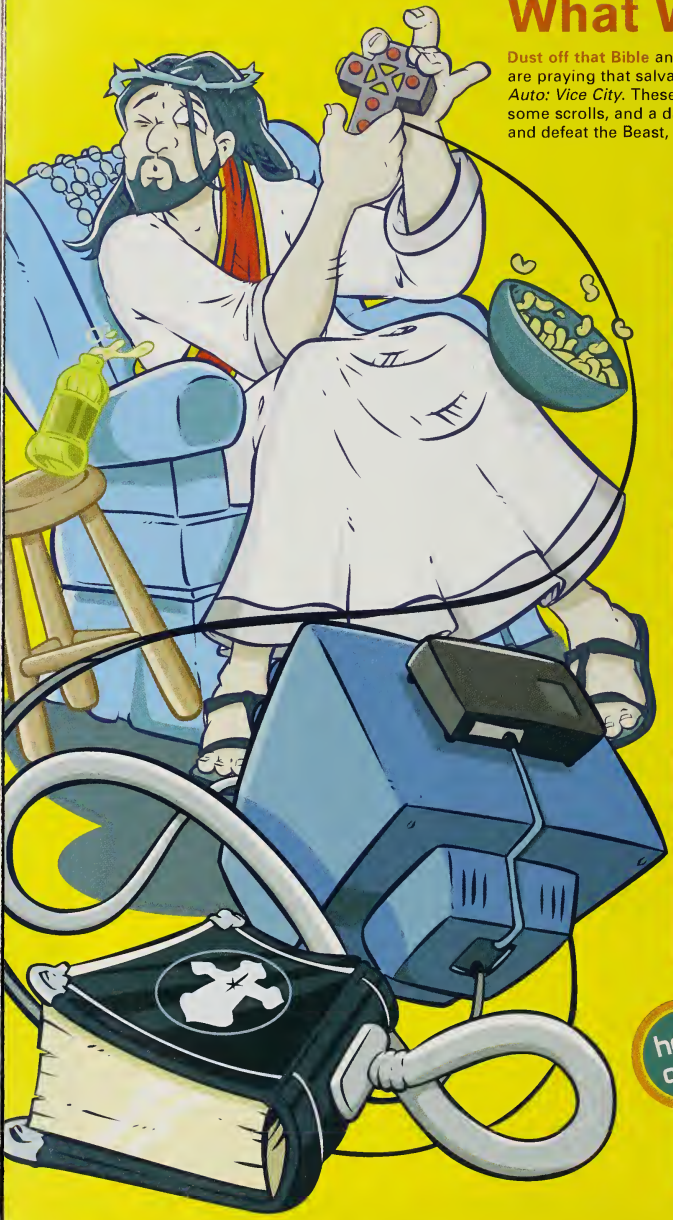
What Would Jesus Play?

Dust off that Bible and get ready for the Rapture. Christian game developers are praying that salvation can be as appealing to the masses as *Grand Theft Auto: Vice City*. These three PC titles let you battle Satan's minions with a staff, some scrolls, and a dagger. Each poses the same challenge: Save some souls and defeat the Beast, or die trying. – **Malcolm Gay**



† ETERNAL WAR: SHADOWS OF LIGHT

MISSION: Travel deep into the suicidal mind of John Coronado to fight the demons of malice and destruction that afflict him. Succeed and John returns to God. Fail and he goes to hell.
FEAR-OF-GOD ACCESSORY: A dagger. When held next to your raised fist, it tosses killing orbs of His energy.
FEATURED HEATHEN: John, the fallen man. He's lost all faith, has no will to live, and is trapped in a cycle of drugs, porn, and self-mutilation. "Who would allow this to happen to someone they love?" John asks. "Answer me that."
CONVERSION RATING: Medium. The low tech graphics make even the power of God seem a little underwhelming. But chats with John will put any player on the righteous path.

† OMINOUS HORIZONS: A PALADIN'S CALLING

MISSION: It's 15th-century Germany, and evil forces have destroyed Johannes Gutenberg's printing press and stolen his Bible. You're charged with retrieving it – and ensuring the rapid spread of Christianity.
FEAR-OF-GOD ACCESSORY: Moses' staff. Known for parting the Red Sea, this powerful piece of wood channels God's energy to strike down evildoers.
FEATURED HEATHEN: The Greater Druid. As if the pagans didn't have it rough enough, they return here as undead warriors.
CONVERSION RATING: Medium-high. This title has the most sophisticated gameplay of the three, and its developers have caught flak for – no kidding – excessive violence.

† SAINTS OF VIRTUE

MISSION: Know thyself. Journey within your own heart to fight the worldly temptations of vanity, pride, and fear.
FEAR-OF-GOD ACCESSORY: Scrolls of Truth. The coveted bits of scripture allow you to unlock the doors of worldly wisdom.
FEATURED HEATHEN: The Golden Guru. A false prophet who attempts to seduce you with earthly delights.
CONVERSION RATING: Low. Overcoming the deadly and lesser sins doesn't make for exciting gaming. Only purists will relish *Saints of Virtue* for keeping its Christian credentials intact.

holy cow!

There's no business like God's business. Estimated sales of Christian videogames, music, books, and movie tickets reached a revelatory $3.6 billion in 2002.

Videogames: **$200 million**	Music: **$900 million**
Books: **$2.5 billion**	Movie tickets: **$35.5 million**

Sources: Box Office Mojo, *Wall Street Journal*, Christian organizations

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Chip Hop Shopping

You go to hip hop shows for ass-shaking bass, wicked performances, and insane lighting. Now you can expect the same when buying a Nike, Sean John, or Ben Sherman outfit for the affair. Michael K., a bi-level retail store in New York's SoHo hood, sells trendy wares inside a fantastic 22,000-square-foot space filled with 42-inch plasma screens, 17,000 watts of audio, and a computer network that's more CNET than MTV. All that gear has inspired the $4 million shop to stay open after hours for parties, like the upcoming New Year's Eve bash starring NYC's hottest MCs and DJs. – **Lucas Graves**

↘ EYE CANDY

Nearly 200 monitors – 3-inch LCDs, banks of giant plasmas, drop-down projection systems – fill the store from floor to ceiling, displaying visuals from 64 sources. Footage comes from DVD, cable, satellite, video, and online streams.

↘ VIP ACCESS

Michael K. gives vendors space on its servers so brands like North Face and Enyce can dial in to upload and cue up custom videos for the in-shop monitors.

↘ IN THE SPOTLIGHT

How do you take advantage of $300,000 of professional lighting? You run it over Ethernet. Michael K.'s club lights, four fog machines, and 2,000 linear feet of LEDs have their own IP addresses, so they can be reconfigured on demand.

↘ SOUND MACHINE

DJs like NY's Clark Kent have a professional booth at their disposal. It houses turntables and has direct access to an 80-gig iMerge music server in the basement. A wireless mike is on hand for visiting talent who want to star in an impromptu show.

JAPANESE SCHOOLGIRL WATCH

Peek-a-Booth

When you care enough to send the very best, you drop trou in a sticker photo booth. That's what high school girls in Japan are doing, anyway. Tired of using Hawaiian backgrounds and *Sailor Moon* anime motifs to spice up their pics, they've begun shedding their clothes behind the curtain instead. *Eropuri*, short for erotic print club, sprouted when phonecams made taking candids easier than dialing for pizza. The young ladies apparently aren't shy about baring it all for full-length group shots, prompting some shopping centers to ban men from loitering in the photo booth area. Guys aren't allowed to peek till the little stickers are developed. – **J Mark Lytle**

STORE: RAIMUND KOCH; STYLIST: JEANNE GRAVES

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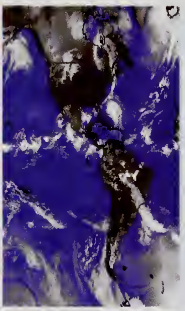
DVD

Lord of the Rings: The Two Towers – Special Extended Edition

There's still no sex in Middle-earth, but this surgically enhanced edition helps clarify why: The Entwives are missing, and Aragorn has been brooding longer than you think – he's 87! (On the other hand, Frodo and Sam …) The 43 added minutes drop no real bombshells; instead they're sprinkled with Shire salt and oedipal guilt, easing transitions and deepening conflicts for *Return of the King*. Special features are tricksy and precious; Sméagol steals the rest of the show. – **W. O. Goggins**



DVD

The Year in Weather

Call it porn for the climate-obsessed. This DVD logs a year's worth of meteorological satellite images from 11 locations. Action-packed storms batter the Pacific Northwest, and hurricanes Claudette, Fabian, and Isabel pummel the Atlantic Coast. The segments, time-lapsed down to 8 minutes each, are set to a Phillip Glass-esque soundtrack. Verdict: It's twice as addictive as the Weather Channel. – **Chris Baker**

DVD

Alien Quadrilogy

Attention *Alien* completists: The definitive nine-disc set is here. It includes all four movies, from 1979's *Alien* to 1997's *Resurrection*, along with an insane 45 hours of bonus footage. Highlights: Multiangle views of chest bursters and the reinstatement of the first film's legendary "cocoon" scene. The ultimate prize though is David Fincher's scrapped version of *Alien*^{3} – 30 minutes longer than the theatrical release. Lucas take note! – **Bill Desowitz**

THEATERS

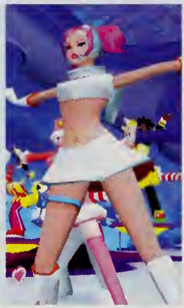
The Fog of War

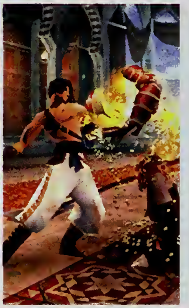
Documentarian Errol Morris (*Mr. Death* and *Fast, Cheap & Out of Control*) tackles history instead of eccentrics when he puts Robert S. McNamara, secretary of defense under Kennedy and Johnson, in the spotlight. McNamara looks directly into Morris' camera at a projection of his interviewer, allowing the director to deftly capture his subject's unspoken inner conflicts. See his eyes flinch as he says the Tet offensive was predicated on bad data. – **Beth Pinsker**

PS2

Space Channel 5 Part 2

Dig out that vinyl mini and those platform boots. In this outrageously entertaining sequel to Sega's groovy rhythm game, you use your control pad to mimic the moves of dance-floor-hogging aliens. Plant your steps with perfect timing to score high and unlock new costumes. Tired of bustin' a move solo? Try an out-of-this-world duet with Space Michael Jackson, voiced and motion-captured by the superstar himself. – **Chris Kohler**





CUBE **PC** **PS2** **XBOX**

Prince of Persia: Sands of Time

When saving the kingdom from evil, timing is everything. Lucky for you, you control the clock. Put foes in slo-mo while you spin around to deal a deathblow. Miss your mark and bite the dust? No problem. Wield your magic dagger to rewind the game and try again. When the action chills between fights, listen to the prince lament – in nearly 800 lines of narration – how the empire was lost in the first place. – **Brian Lam**

PS2

Fatal Frame II: Crimson Butterfly

This survival game has a harrowing twist. Twin sisters battle tortured souls armed only with an antique camera. The lens captures what the mortal eye can't, or won't, see and destroys phantoms in the process. The convincing Japanese environs and dialog add beauty to a title that's essentially about the suffering caused by tearing apart what's joined – whether it be twin sisters or a butterfly's wings. – **Chris Hudak**

CUBE **PS2** **XBOX**

I-Ninja

The cute teenage ninja you channel may look harmless, but he's full of murderous rage and armed with all sorts of trick moves. Beyond the usual run-and-jump antics, he can grind rails, ride half-pipes, pilot giant robots, and hang in midair for endless wire-fu death duels. Add cut scenes animated by Don "*Dragon's Lair*" Bluth and you've got enough mad flava to push Mario right off the radar. – **C.B.**

> 10:45 pm. Account Manager Erin Bliss finishes Advanced Linux Volume IX. Meanwhile, husband Gary begins XP For Dummies.

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music

Basement Jaxx

Kish Kash

It's tough to make a mash-up of house, hip hop, and punk that blends together smoothly. But Basement Jaxx has done it again. Vintage synthesizers, drum machines, and samples still prevail in the London duo's heavily layered rhythms, but guest vocalists – such as '80s phenom Siouxsie Sioux ("Cish Cash"), rapper Dizzee Rascal ("Lucky Star"), and nu-soul sister Meshell Ndegéocello ("Feels Like Home") – keep the sound fresh. – **Stacy Osbaum**

Iggy Pop

Skull Ring

Although they play on only four songs, the Stooges color *Skull Ring* with the subtlety of a splatter gun. The band pounds along on the title track like it's 1969 (or, for that matter, "1969"), and their concerns haven't changed much, either: The chorus is "Skull ring / Fast cars / Hot chicks / Money." The animalistic thud on the rest of the album comes courtesy of Pop's own band, as well as Green Day and Sum 41, who probably learned all three chords they know from the Stooges. – **Robert Levine**

Nelly Furtado

Folklore

Furtado blew critics away and went multiplatinum in 2002 with a musical grab bag of hip hop, pop, and bossa nova. Here the singer-songwriter cranks it up a notch. She sings in her parents' native Portuguese on the club-ready "Fresh Off the Boat," shifts to postmodern folk (with Bela Fleck on banjo) on "Forca," and ramps up the worldbeat rock on "Explode." This is high-energy, tambourine-smacking confection.
– **Beth Johnson**

Kid 606

Kill Sound Before Sound Kills You

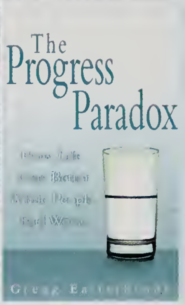
Kid 606 may be the best known of a recent bumper crop of IDM laptop wunderkinds, but that doesn't mean his intelligent dance music translates well to the dance floor. With digital hardcore drill-beats, acid-rave squeals, raga-tempered jungle rhythms, and thrashing breaks that leap gleefully past the 180-bpm mark, the album would just as well replace a trip to the dentist. Thankfully, the final ambient track slows the pace enough to allow for gentle reentry into reality.
– **Adrienne Day**

print

Bond Girls Are Forever: The Women of James Bond

Maryam d'Abo and John Cork

Step aside, Q. Bond babes stimulate the inner adolescent in a way that gadgets never could. Former Bond girl Maryam d'Abo and franchise documentarian John Cork present an astute literary and cinematic critique of these characters as icons of feminine strength. Of course, they also offer up more than 100 distractingly gorgeous photos of the women from the films in large, um, glossy format. – **Michael Myser**



The Progress Paradox: How Life Gets Better While People Feel Worse

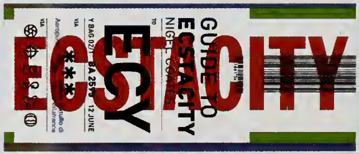
Gregg Easterbrook

Surprise! Wealth, education, mobility, and life expectancy are all trending up for average Joes worldwide. And yet we still kvetch. Easterbrook's prescription for all the whiners, nitpickers, and stress cases: Forgive those who wrong you, be thankful for life's little blessings, raise the minimum wage, and spread the wealth to developing nations. In a few generations, even the poorest will complain about dropped cell calls instead of hunger. – **Josh McHugh**

A Guide to Ecstacity

Nigel Coates

Visionary British architect Nigel Coates rethinks the conventional city. Part monograph, part manifesto, his fictional "travel guide" melds London, Cairo, Mumbai, New York, Tokyo, Rome, and Rio de Janeiro into a hip update of Epcot Center. But Coates throws so many of his real-life projects into the mix that the book is better read as a quirky tour through his inventive mind than a utopian map to the city of tomorrow.
– **Reena Jana**



Lonely Planets: The Natural Philosophy of Alien Life

David Grinspoon

Grinspoon tackles E.T. in a style that will satisfy science nerds and English majors alike. Drawing on astronomy, biology, and pop culture, the NASA adviser validates the big bang theory, traces the human search for aliens, and suggests that extraterrestrial life, at least on a microbial level, is out there. Read closely: Illustrations such as the Cosmic Evolution chart that puts Hendrix at the peak of complex civilization offer some of the wittiest insights. – **Jessica Hilberman**

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VIEW

Opinion • Ideas • Provocations

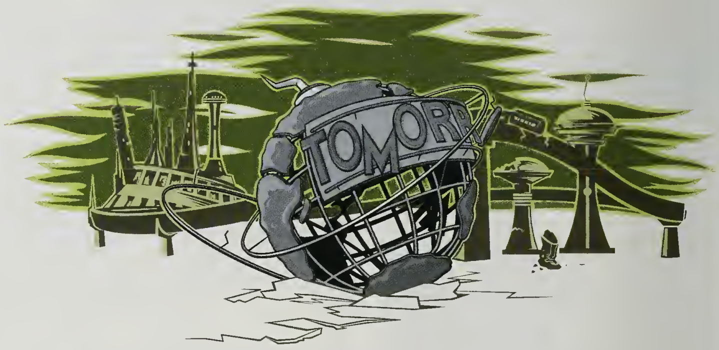
QUESTION

Why do videogames based on movies suck?

Jason Della Rocca
Program director, International Game Developers Association
Time constraints are a big factor. Developers may cut corners to get the game out in time for the movie's premiere. Also, some developers become lazy and use the license as a crutch. Just like if I have J.Lo in my movie, I'm guaranteed a rate of return: I get a big opening weekend even if my movie really sucks.

Seamus Blackley
Xbox cocreator;
VP of development, Capital Entertainment Group
Market pressures come to bear – how much did the *Matrix* license cost? You may have heard that games are bigger than film. That's a myth of creative accounting. We are Hollywood's bitch. We're paying an extortionate amount of money to license other media – comic books, TV, movies – and we're simultaneously giving up on our ability to make our own intellectual property. If we let it go on this way, games may become just a marketing device.

Jason Rubin
President and cofounder, Naughty Dog, makers of *Crash Bandicoot* and *Jak & Daxter*
Don't forget, the *Matrix* game sold very well. The *Hulk* and *Spider-Man* games also did very well, considering the content. *Star Wars* games – well, some of them are great and some of them aren't, but they sell. The bottom line is that fans desperately want to immerse themselves in the worlds of these franchises, and they're willing to pay for it and put up with shortcomings in the gameplay.



Futurism Is Dead

Need proof? Try 40 years of failed forecasts. by Hope Cristol

Ed Cornish, founder of the World Future Society and its president since 1966, leans back from his computer – a DOS machine that doesn't do email, the Net, or Windows.

Clifton Coles, assistant editor of the society's flagship magazine, *The Futurist*, pokes his head into his boss's office: "A Seattle radio station called, wants to know if you have some predictions for next year." Cornish, 76, strokes his nipples in a circular motion, stares off for a second, and says, "I can't think of anything in particular."

When the president of the World Future Society is baffled by a simple request for a prediction – any prediction – it's a sure sign that the field as a whole is in trouble. It's not the only sign. No major newspaper covered this year's WFS conference; that was left to *The Manila Times* and the *Cincinnati Business Courier*. The society's membership rolls are down 20 percent compared with 10 years ago. And a WFS member hasn't been invited to the White House since the Reagan administration. The list goes on.

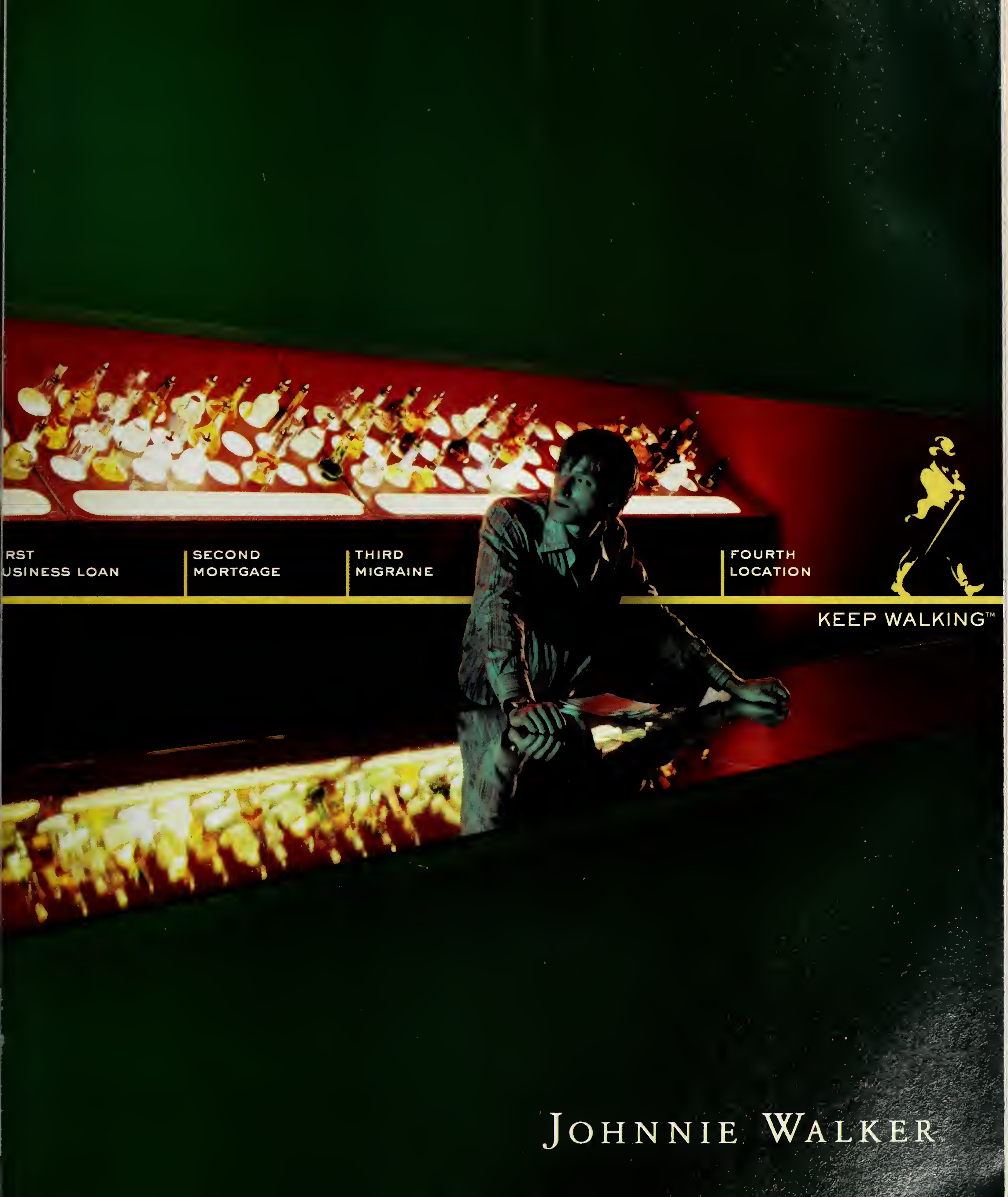
Long gone are the days when Isaac Asimov, Buckminster Fuller, and Arthur C. Clarke made headlines with their prophesies. Today, we have João Pedro de Magalhães, who says that if we eliminate age-related diseases, we can expect an unlimited lifespan (a tautology). We have H. Paul Shuch, who says that earthlings should abandon planetary paranoia and transmit warm greetings to other young civilizations in space. We have Susan Clayton, who predicts that in the next decade or two, we'll be able to talk to animals – in *their* language.

Futurism is doomed and not just because fools are endemic to the field. It's doomed because the loosely informed, jack-of-all-trades, trend-watching pontificator (read: professional futurist) is obsolete.

THERE'S NO SUCH THING AS A CRYSTAL BALL

For starters, we now have a plethora of niche consultants and a booming field called risk analysis, which uses proven actuarial methods. "Everybody's more specialized, so there isn't a market for someone who can speak about very large, holistic matters with any authority," says Mike Marien, a recovering futurist and an outspoken critic of the field.

Further, we've wised up to the fact that futurism as a discipline is something of a con: Futurists don't have a crystal ball. They examine trends and play out what-if scenarios. Any hausfrau with gumption and a dialup connection can do it. "Does



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2003 WIRED RAVE AWARD **TV CREATOR**

With Fox's *24*, Robert Cochran and Joel Surnow have proven that network television doesn't have to conform to stale trends in order to gain mainstream raves. In an industry that churns out copycats and clones, the duo has created a true anomaly — a show that is as groundbreaking as it is entertaining. *24*'s major achievement is its innovative structure; each season of the espionage thriller consists of a single story line that unfolds in "real time," with each episode covering one hour in one day. The result is taut, edgy programming that is a smash hit with both critics and audiences. Truly, time is of the essence.

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SHoP ARCHITECTS

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2003 WIRED RAVE AWARD **ARCHITECT**

New York's SHoP represents a progressive architectural ideology that embraces cutting-edge design and manufacturing tools without indulging in technophilia. The award-winning firm borrows methods from the worlds of software design, film, finance, fashion, and politics, displaying a deep understanding of the complex relationship between the conceptual and physical worlds. The company's principals recently published a book titled *Versioning* to describe this model, which connects the emerging theories of the digital age with the fundamentals of materials and construction. These bright young talents have developed a diverse repertoire that includes everything from a waterfront park on Long Island to the Rector Street Pedestrian Bridge, which reconnects the neighborhoods surrounding the former World Trade Center to the rest of Manhattan.

(ABOVE) CHRISTOPHER SHARPLES, WILLIAM SHARPLES, COREN SHARPLES, KIMBERLY HOLDEN, GREGG PASQUARELLI

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Published first set of software.
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← intelligent thinking add up to a futurist field? I don't think so," Marien says.

Finally, futurism is obsolete because it now has a past: Forty years of failed predictions should be enough empirical evidence to turn even the true believer into a skeptic.

A recent example: Watts Wacker, a well-known and well-paid futurist consultant, predicted in late 1999 that the US Postal Service would offer customers free email accounts within two years. He said USPS had the ideas and the will to make it happen, that "they've done their homework." Four years later, where's our email? "This is the first I've heard of the idea," says Gerry McKiernan, manager of media relations at USPS. "If we don't sell stamps, we can't pay our employees." As it turns out, Wacker didn't do *his* homework.

Of course, if you make enough predictions, you're bound to get something right – especially when the predictions aren't much of a stretch. For instance, a few futurists (including Wacker, in 1997) predicted that terrorists might someday hijack a plane and crash it into a building. But is that really prescient? By 1996, Tom Clancy had written two novels based on the premise.

Futurists are the first to say that futurism isn't about telling the future; it's about examining trends and fleshing out scenarios. Yet they consistently spout predictions, somehow confident in their authority as futurists. The logic here is circular: Futurists insist that their scenarios, as exercises in creative thought, should be exempt from success-measuring metrics. But should one of those shots in the dark hit its target, they credit their "scientific" methodology.

"When futurists predict something, years down the road no one remembers if they're proven wrong," says Eric Garland, professional futurist and president of the Washington, DC, chapter of the WFS. "If they're lucky enough to be right, they get to brag about it."

It's not just that the futurist has no clothes, it's that the futurist has no shame.

Freelance writer Hope Cristol (hcristol@verizon.net) *was once a futurist-in-training.*

ANY HAUSFRAU WITH A DIALUP CONNECTION CAN STUDY TRENDS

hot seat

Mark Cuban

Remember when notorious loudmouth Mark Cuban and his business partner, Todd Wagner, sold Broadcast.com for $5.7 billion? They've been spending the proceeds on a variety of film production and distribution firms (and the Dallas Mavericks) ever since. Now the duo have their crown jewel, Landmark Theatres, the largest US art-house chain. Put it all together, and Cuban thinks he's ready to turn filmmaking on its ear. A revolution, or a throwback to the Hollywood conglomerates of old? – **Xeni Jardin**

I'm a Maverick, Not a Mogul!

WIRED: How does Landmark fit into the Mark Cuban empire?
CUBAN: We produce movies in the $10 to $25 million range through our company 2929 Productions, and films in the $1 million range through [our television network] HDnet. We can take the best of our films and the best of others', and display them in theaters or on HDTV. Everything will be digital, which gives us the freedom to break the business rules that everyone in Hollywood plays by.

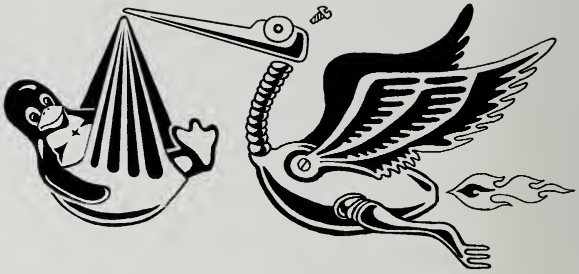
For example?
Why can't I preorder a DVD and receive it the day the film is released in theaters? Or buy it on my way out of the theater if I liked what I saw? One thing I learned from the Mavs is that you can watch the game on TV, but you'll still go to the game, because it's a different experience.

How is this any different from the studio conglomerates that led to antitrust laws?
Digital makes filmmaking cheaper and more accessible, so we see ourselves as a conduit for new, independent voices who'd otherwise never have a shot. You could shoot your film on digital, dump it on a hard drive, edit it on a laptop, send us that file, and 20 minutes later we could show it in a theater or upload it to a satellite. You could say that if we became huge, we'd risk becoming a Microsoft. But if we become huge, we want to become more like a Linux.

Are you concerned about piracy in movie theaters?
Not one bit. If we can't compete with some guy sneaking a camera into the theater, or a blurry, encoded, postage stamp-sized file, then please – just shoot us.

What makes you the best guy to pull this off?
Maybe I'm not. But technology is always going to do its job. My strength is being able to recognize the obvious in a digital world and turn it into a business.

SCOTT MENCHIN



Linux: The Next Generation

How free software is fueling a new kind of patriotism. by Bruce Sterling

The autonomous region of Extremadura, in the bucolic southwest of Spain, is all hills, grapes, oaks, and olive groves. Centuries of industrial progress have breezed right by this place. Today it's an ecotourist bird sanctuary dotted with timeless farming villages. In the long siesta hours, dogs practically amble after cats.

But this quaint haven has suddenly become a bastion of Tux the Penguin. Extremadura has gone whole hog for free software: *¡Software libre para la libertad!* Its government has minted some 80,000 CDs to marinate the populace in Linux. Social workers carry the latest open source code to remote schools, municipal offices, and city-funded ISPs. Thanks to Juan Carlos Rodríguez Ibarra, the left-wing academic who became regional president and has dominated local politics for the past 20 years, the Global Project for the Development of the Information Society aims to give every resident access to the knowledge gathered by humanity throughout history.

Ibarra's ambition is born of desperation. Extremadura suffers chronic brain drain to Madrid, Valencia, Barcelona, and hubs throughout South America. This trend is centuries old – the conquistadores Cortez and Pizarro were both from Extremadura. It's a pretty area, but there has never been much to do here. Unemployment is a staggering 22 percent.

As a business, it makes no sense to wire Extremadura's scattered hamlets. If the locals weren't given Net access by state fiat, they'd never manage to pay for it. They can't afford fancy brand-name software, either. So they have two choices: sit on their hands and watch the information revolution pass them by, or boot up a new kind of digital socialism.

Luis Casas Luengo, a sometime Eurocrat and expert in technology transfer, kindly demos the product for me: a local version of Debian GNU/Linux, translated into Spanish and renamed LinEx. Technically, there's nothing wild or woolly here. LinEx comes with what most folks really need from a computer: word processor, graphics processor, spreadsheet, emailer, browser, chat client, MP3 player, CD burner.

The features may be mundane, but they add up to something quite new: a patriotic regional operating system. The emailer's logo is a stork, Extremadura's most beloved bird. The word processor is named after a famous local poet. The desktop is crammed with hallowed symbols of the homeland. Extremaduran schoolkids could stand up and pledge allegiance to this thing.

Free software has always been free for the sake of technologists, providing open range for code wranglers and server farmers. Now Extremadura is claiming it for the *campesinos*. Here, open source isn't about the process of collaborative development or objections to intellectual property. It's about power to the people. The LinEx stork is a direct connection to the global economy.

This deeply rooted regional approach could prove a more nurturing environment for Tux than either the EU, with its stifling bureaucracy, or the US, where lawyers for SCO are eager to sue the daylights out of anyone who dares to propagate the penguin. Right now, most of the action is in government, where officials are beginning to wake up to the advantages of open standards and malleable code – and not having to pay Americans for any of it. India is releasing Linux variations in local dialects from Assamese to Telugu. China, Japan, and South Korea are collaborating on their own OS. South Africa recently approved an open source strategy, and similar things are going on in Argentina, Australia, Bulgaria, Peru, and Ukraine.

LOCAL VERSIONS ARE EVERYWHERE FROM SÃO PAULO TO SEOUL

These initiatives, as dramatic as they are, directly benefit only functionaries and tax collectors. Those who, like Extremadura's Ibarra, view open source as force for social liberation have their eyes on Brazil, which is now run by Luiz Inácio Lula da Silva, the former union leader turned president of the world's fourth largest democracy. Lula is the new darling of the global left. In Extremadura, he's considered the vanguard of social progress.

Brazil hosted the recent Fourth International Forum on Free Software, held in the World Social Forum's stronghold of Porto Alegre. There, jazzy pop star Gilberto Gil, now Brazil's minister of culture, promised to "tropicalize digitalization," presumably a reference to bridging the developed and developing worlds. If Extremadura is the harbinger, those tropicalized digits will be globally connected, fiercely patriotic, and free as sunshine.

Email Bruce Sterling at bruces@well.com.

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Fiber to the People

When customers own the network, everyone wins. by Lawrence Lessig

Burlington, Vermont, is building a network. Like many municipalities across North America, it has decided to construct an advanced fiber network on its own. The AFN is being deployed first to support city services. Then, as part of the four-phase project, this municipality of just 40,000 will extend blazingly fast Internet service to businesses and residences.

To many, this just looks like more socialism from Vermont. Why should government be in the business of providing high-speed networks? Isn't that what free markets are for? Haven't we all learned that the market is more efficient at supplying goods and services? Do we really need to rediscover the failings of Karl Marx at 100 megabits per second?

The answer, as Cornell economist Alan McAdams argues, has nothing to do with Karl Marx and everything to do with basic economics. AFNs are natural monopolies. That doesn't mean that there can be only one, but rather that if there is one, then it is far cheaper to simply add customers to the one than to build another. The electricity grid in a local neighborhood is a good example of a natural monopoly. Sure, we could run four wires to every home, but do we really need four electricity companies serving every home?

Most economists would leap from the premise of a natural monopoly to the conclusion that such a monopoly must be regulated. But regulation is not the end that McAdams seeks. Ownership is. If a traditional network provider owned an AFN in a particular area, that network provider, acting rationally, would charge customers a monopoly price, or restrict service to get its monopoly benefit. But if the customer owned the network, then the customer could get the same access at a much lower price and be free of use restrictions. McAdams is pushing – and Burlington and other cities are actually deploying – customer-owned AFNs.

The point is obvious when you think about corporations. Boeing, for example, has installed a massive AFN on its campuses. That AFN enables the company to offer itself extraordinary network capacity at extremely low cost. Technically, Boeing is the monopoly provider of network services to Boeing. But as McAdams nicely puts it (so nicely that we might call this the McAdams theorem), you don't monopolize yourself. Boeing gets cheaper services than if a network provider owned the same natural monopoly – indeed, vastly cheaper, McAdams argues, when you look at the efficiencies of AFNs.

The sticking point, however, comes whenever governments get involved. And no doubt, this is skepticism with good reason. But city council members are not stringing AFNs; nor is fiber being manufactured in local communes. Instead, global firms such as Black & Veatch string the fiber and set up the networks. These companies don't own the networks they build, any more than highway contractors own the highways they build. Yet because they operate in a competitive market, the service they provide is efficiently priced. They build the networks that the customer owns, and the customer escapes the burden of a monopolist network provider. The key is ownership, and the different incentives that ownership creates.

For a long time now, the FCC has been pushing the idea that ownership matters. In the past four years, it has relaxed common-carrier-like regulations on cable and telecom providers on the theory that otherwise these companies won't have enough incentives to deploy broadband networks. Common-carrier regulations, this view fears, would transform IP traffic into a commodity. And capital markets aren't eager to fund commodity infrastructures.

THINK HIGH SPEEDS, LOW PRICES, NO RESTRICTIONS

That might be right about cable and telecom companies. Freeing AOL and Comcast from some regulation might be the only way they could afford to deploy high-speed access. But it doesn't follow that AOL and Comcast are the most efficient providers of high-speed network access. They might not want to be in a commodity business, but commodities are precisely the efficiencies that drive economies. And as more firms persuade more municipalities to develop competing high-speed networks, then we might learn again why GM doesn't own the highways, and why neither cable nor telecom companies should own IP access.

Lawrence Lessig (lessig@pobox.com) *is a professor at Stanford Law School.*

Find all 18 things we changed in this picture? Get the answers at vw.com/jetta.

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WIRED TOOLS 2K3

Tech gear is fun again – whether you're into 3-D computer screens, smartphones, theater-quality home audio, or DNA kits for kids. Our crack squad of geeks has rounded up 77 innovative playthings that'll keep you entertained till next holiday season.

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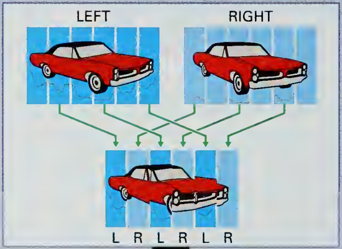
[SCREENS + MONITORS]

by Bob Parks and Michael Myser

3-D BUSTS OUT

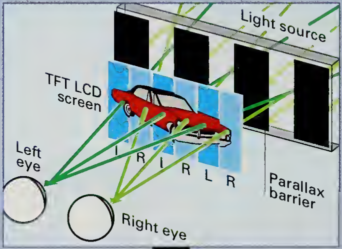
The 3-D screen, a fixture of sci-fi and mad inventor fantasies, is finally getting real. The new tech is called autostereographics, and it applies recent breakthroughs in optical science to traditional LCDs, delivering 3-D video without the dorky glasses. The screens are flat, relatively cheap, and ready for commercial applications like gaming, digital photography, online shopping, and, inevitably, porn. Sony, Microsoft, and dozens of others are working to create compatible hardware, software, and content. First out of the gate is Sharp with a laptop screen that lets you toggle between 3-D and 2-D – eye-popping games one minute, productivity apps the next. (After all, you wouldn't want to do your taxes in 3-D.) The 10-pound Actius RD3D runs Windows XP and features a 2.8-GHz processor, a hi-res 1,024 x 768-pixel screen, and 512 megs of memory.

[**Actius RD3D:** $2,999, *www.sharpsystems.com*]



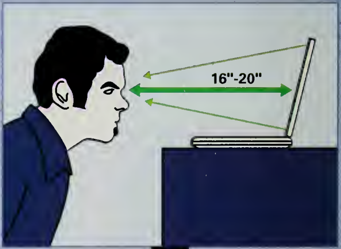
▸ Autostereographics at Work

When you look around a room, your eyes send two slightly different images to your brain, which interpolates them for depth perception. To make 3-D films and videogames, content producers create two videostreams to imitate left- and right-eye perspectives. Each frame of footage is digitally cut into thin vertical strips; alternating strips are then spliced together to form a single frame in which a line of pixels from the left stream is followed by a line from the right. The resulting image is a blur unless you have the right hardware.



▸ Parallax Barrier

By carefully directing light, Sharp's display uses a filter called a parallax barrier to transform that blur into 3-D magic – no lame eyewear required. As with any LCD, the RD3D's light source comes from behind, but in this case it passes through the barrier on its way to the screen. The barrier splits the light, creating right and left beams that are directed at each eye. Your brain then combines the two into a single 3-D representation. To return to the drab 2-D world, just flip a switch and turn the barrier off.



▸ Sweet Spot

For the maximum 3-D experience, your head needs to be 16 to 20 inches from the monitor. The RD3D flashes directions onscreen that become fully visible once you're properly oriented. The parallax barrier cuts resolution in half, but it's still a striking effect. Hundreds of games – like *Unreal Tournament* – already support the process. The added depth intensifies your immersion, but staying in the sweet spot can be a painful challenge. Sharp hopes to expand the field of view in future products.

GLOSSARY

TYPES OF TVS

tube CRT
If you were born before 1985, you probably grew up watching one of these boxy sets. Though the tech inside is bulkier than others, its picture quality still beats the rest.

rear-projection CRT LCD DLP
These TVs beam images onto the display from behind and were the first to master the truly big screen (40-plus inches). They're significantly cheaper than flat panels but still provide the large screen size. If you've got the room but not the cash, they're a good buy.

flat-panel LCD PLS
On everyone's wish list, flat panels have a hefty price tag that adds serious weight to their light-as-a-feather presence. The larger screens can be hung like artwork for an admiring public; smaller ones are ideal for doubling as a desktop computer monitor.

front-projection LCD DLP
Just like a movie projector, these systems cast images onto a white screen, a wall, or even a ceiling. The signal can come from any source – DVD player, laptop, satellite, et cetera. Pricey, yes. But at least you won't have to pay 5 bucks for popcorn.

THE TECHNOLOGIES THEY USE

cathode-ray tube
CRTs beam a tight ray of electrons onto a phosphor-coated glass screen. Tube TVs use a single cylinder; rear-projection sets use three to shine the separate red, green, and blue elements of an image onto the display.

liquid crystal display
One layer each of liquid crystals and color filters are pressed between two sheets of glass. The crystals act like shutters, blocking light until they're zapped with electrical current. When charged, they allow light to pass through and onto the screen.

plasma
Plasmas heat up neon and xenon gases sandwiched between two layers of glass surrounded by electrodes. When juice flows between two electrodes – whose right angles form one pixel – the gas mixture breaks down and emits UV radiation. This activates color phosphors in the pixel.

digital light processing
The heart of this system is an optical chip covered with up to 1.3 million tiny mirrors, each representing a pixel onscreen. The mirrors direct white light through a color wheel with red, blue, and green filters.

MOTHER OF ALL WEGAS

Sony started small to make a big impression. While most rear-projection TVs still use traditional CRTs, the 60-inch-wide WEGA drops the tubes and gets its picture from three 1.35-inch LCD panels, each of which projects a different color – red, green, or blue. The new tech makes the set half as deep (14 inches) and a third as heavy (110 pounds) as similarly sized rear-projection boxes. Though it's still not as slender as a plasma panel, the WEGA offers a lot more detail at half the price. A resolution of 1,366 x 768 pixels means the images are so sharp you can see celebrities' panty lines.

[**Grand WEGA KDF-60XBR950**: $5,500, *www.sonystyle.com*]

A THREE-WAY FOR THE FREEWAY

With 384,000 pixels, Alpine's motorized dashboard monitor boasts three times as much detail as other in-car displays. The 7-inch widescreen monitor is bundled with a DVD player and stereo receiver capable of pumping two sources to three discreet areas. Play *2Fast 2Furious* for the speed demon riding shotgun, or Mötley Crüe's *Music to Crash Your Car To* for the slacker in the backseat, and pump classical radio to the overachiever in the way back. It's the end of "Are we there yet?"

[**IVA-D900**: $2,300, *www.alpine-usa.com*]

CORDLESS TV

Take Sharp's 15-inch high-style monitor anywhere on your estate. Connect the included transmitter to your cable feed or DVD player and the 11-pound LCD receives video and audio wirelessly over the 2.4-GHz band from up to 300 feet away (a lithium-ion battery powers it for up to three hours). It's the perfect backyard grilling companion – but it's not waterproof, so be sure to pull it inside at the first sign of rain.

[**AQUOS LC-15L1U**: $1,799, *www.sharpusa.com*]

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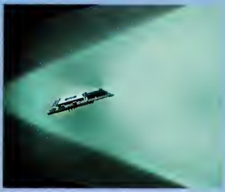
CAUTION :DO NOT LOOK INTO LENS.
ATTENTION :NE REGARDEZ PAS A L'OBJECTIF.
VORSICHT :NICHT IN DIE LINSE SEHEN.
HOW TO REPLACE HANDLE
① PUSH DOWN
② TURN



EXTREME CLOSE-UP

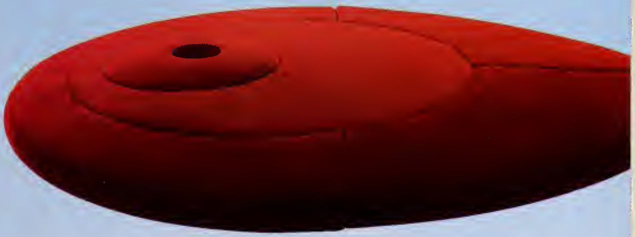
At your age, you can't get away with a magnifying glass and a jar of spiders anymore. The best show-and-tell sessions start with NEC's DT20. The hi-res projector lets you view solid objects – whether seashells or computer chips – placed on its glass top. The blinding 2,800 lumens present images of the items at 1,024 x 768 pixels (shown above), a resolution that matches the best data projectors, but its video inputs allow for only standard – not hi-def – sources. The lens zooms in as much as 625 percent, and a built-in digital camera can record your projections for future reference.

[**DT20:** $6,195, *www.necvisualsystems.com*]

SCREENINGS ON THE CEILING

Getting horizontal to watch a movie at home can be a real pain in the neck. Philips' solution: a couch that projects the action onto the ceiling. Designed with the help of Italian furniture maker Cappellini, the 11.4-foot-wide oval sofa features an embedded multiformat DVD player and a super-silent widescreen video projector. The 1,100-lumen bulb can cast images 20 feet wide, up to 33 feet away – though with only 858 x 484 resolution, it doesn't do HDTV.

[**Vesuvio Sofa:** $31,000, *www.philipsusa.com*]



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IF LOOKS COULD KILL ...

A hardcore gamer shouldn't trust anybody else's setup. Tote NEC's 17-inch fold-up LCD to your buddy's *Half-Life 2* competition and you won't have to worry. Using its dual-hinge neck, you can make a pancake out of the 13-pound display, then store it flat in your trunk or messenger bag. The screen shows off images with a 1,280 x 1,024 resolution at a fast 16-millisecond response time (other screens clock in at 25 milliseconds). A tough sheet of acrylic protects the monitor's surface. When you get to the battle, plug it into the wall, connect it to a Mac or PC, and play like there's no tomorrow.

[**LCD1765**: $549, *www.necmitsubishi.com*]

MUST-SEE HDTV

Fact: Even bad sitcoms look good on plasma. Loewe, German maker of luxury TVs, sexes up the lamest shows with its glamorous 42-inch Spheros. The panel's 1,024 x 1,024 resolution flatters any HDTV signal. Where film's diagonal lines sometimes appear jagged on plasma, this set runs a special anti-aliasing algorithm to fix the problem. Throw in an optional matching remote control and motorized stand to spin the screen your way and you'll never want to leave the couch again.

[**Spheros 42**: $11,000, *www.loeweus.com*]

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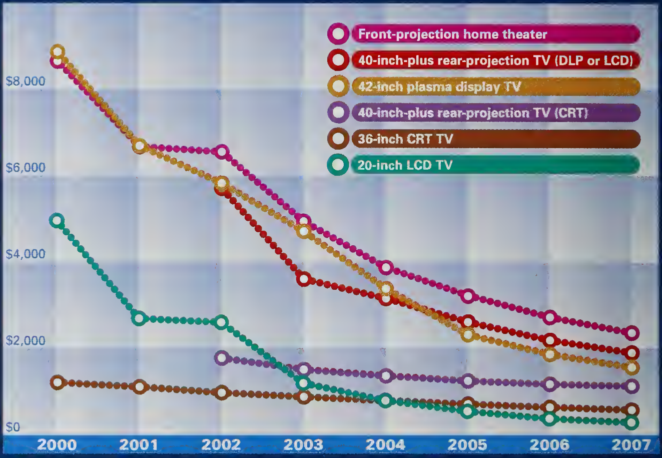
THIN IS IN

Falling prices make alternatives to tube TVs affordable

The days of big and boxy TVs are over. LCDs, plasmas, and projectors are getting so cheap that even typical couch potatoes – and not just early adopters – can afford them. Prices on the slimmer sets have dropped 40 percent since 2000, and they'll continue to fall as manufacturers cut production costs, says Paul Semenza, an analyst at iSuppli/Stanford Resources. Some companies are pricing their plasma sets below cost to spur sales, he adds. LCDs are even more affordable because volumes are higher – they appear not only on that TV you're about to buy but on your new laptop, PDA, Game Boy, and cell phone. Meanwhile, picture quality and product design continue to improve. With all that competition, manufacturers are being forced to drop their prices as well. What are you waiting for? Check our chart to see how soon one will fit into your budget.



Sources: iSuppli/Stanford Resources, NPD Group, *Wired* research

THE PLASMA SLAYER

Samsung's 54-inch LCD outperforms rival plasmas in three ways: It uses a fraction of the electricity, shows a higher-definition picture, and lasts three times longer. Samsung's 3-inch-thick display is currently the largest consumer LCD in the world, can hang on a wall, and boasts enough resolution (1,920 x 1,080 pixels) to show full HDTV. Computer inputs make it a hell of a surface for *Warcraft*.

[**LTN545W**: $25,000-30,000, *www.samsungusa.com*]

INSET: COURTESY BLIZZARD ENTERTAINMENT

+ Celebrity Stuff +

"I can't live without my cell phone. It's the one with the big round dial, and it has a video camera on it. I have a ring tone of my sister, and she's screaming and singing on it. It's pretty funny."

PARIS HILTON

Model, hotel heiress, actress

Her Favorite Gear

[01] 42-inch Sony Plasma WEGA
[02] Nokia 3650 phonecam
[03] T-Mobile Color Sidekick

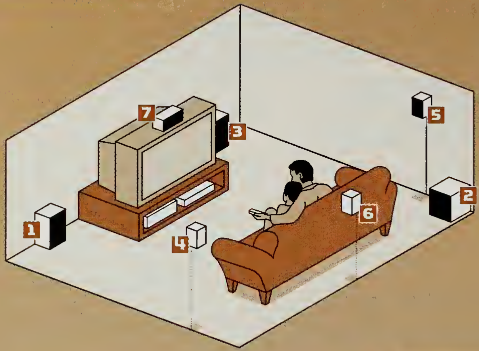
Her Wish List

"I want to get a huge, giant, the biggest flat screen you can get. Someone told me there's like one that's the size of a movie theater screen, but I don't believe that. I also want to get a lie detector on my phone. I've heard about those at the spy shop. You can talk on the phone, and it will read the people and tell if they're lying or not."

Vehicle shown $53,345. Tax, title, license and other optional equipment extra. 1.800.REAL.4WD © General Motors Corporation, 2003. HUMMER and the vehicle's grille design are registered trademarks of GM Corporation.

[SOUND SYSTEMS]

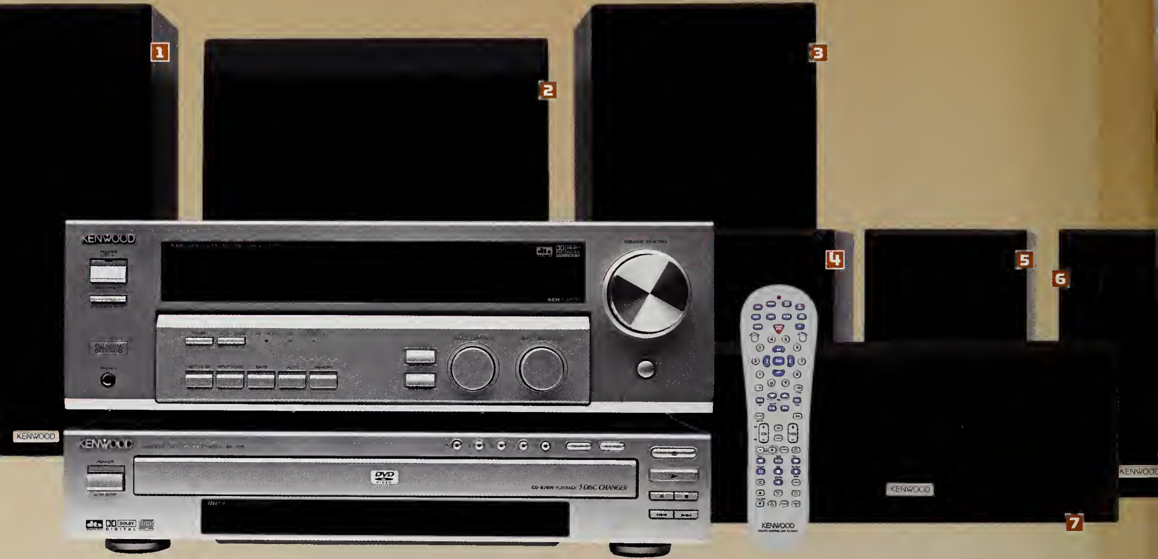
by Paul Boutin



THE SIXTH SENSE

Theater-quality surround used to be strictly for millionaires with electrical engineering degrees. And even if you had the money and patience to install it, the hulking array of speakers made your den look like Stonehenge. Kenwood's HTB-806DV is the first to squeeze state-of-the-art 6.1 sound into a compact 2 x 2 x 3-foot "home theater in a box" kit. The six tiny speakers and subwoofer won't overwhelm your home decor, and the quick setup (60 to 90 minutes) won't overwhelm you.

[**HTB-806DV**: $600, *www.kenwoodusa.com*]



Surround Sound

Star Wars: Episode 1 introduced 6.1 surround sound to the megaplexes. The HTB-806DV adds a sixth speaker [6] to the standard configuration, between the left [4] and right [5] rear channels. Combined with the left [1], right [3], and center [7] front speakers, it lends an unprecedented sense of audio dimensionality.

Powered Sub

A powered subwoofer [2] produces a tighter, stronger thump than one with separately wired amplifiers. The HTB-806DV's sub is rated at 150 watts, bringing the system's total wattage to 750. It delivers supercharged thumping bass – maybe more than you need. Turn on Midnight Theater mode to automatically hush loud sounds like gunfire.

Universal Remote

Once you've plugged your TV, cable box, cassette deck, stand-alone CD player, and VCR into the HTB-806DV, ditch all their remotes. The 806's universal controller is preprogrammed for most newer components and can be configured to handle older disc players, tape machines, or set-top boxes. Can it start the microwave, too? Maybe.

Receiver

DVDs come in a perplexing array of multichannel audio formats. The Kenwood receiver recognizes and processes the most popular ones: Dolby Digital 5.1, Dolby Digital EX, Dolby Pro Logic II, DTS Digital Surround, and 6 Channel Analog. In addition to theater mode, the equalizer lets you opt for arena, stadium, jazz club, or disco.

Disc Player

Go ahead, insert that MP3-encoded CD. If you've got music in disc format, the HTB-806DV's disc drive can play it. This one reads CD, CD-R, and CD-RW. And it plays DVDs, too. It can pull the DVD-Video signal from DVD-R, DVD-RW, DVD+R, or DVD+RW discs.

HOLIDAY DIGITAL from PENTAX

PENTAX
Optio S4

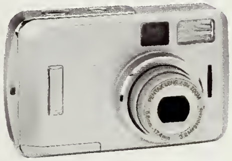
Not bigger, just better. The Optio S4 is the newest generation of the popular digital camera that fits in a breath mint tin. Now it boasts a hefty 4.23-megapixels, a 3X zoom lens, movie mode with sound and a variety of features including a large, easy-to-use manual control dial. $400

PENTAX
Optio 555

Highly responsive 5-megapixels, 5X zoom lens exceptionally compact and lightweight design with 20X combined zoom. $550

PENTAX
Optio 33LF

An "all around" digital camera, with an innovative LCD monitor that swivels 180 degrees horizontally and 270 degrees vertically. Optio33LF features 3.2-megapixels, a 3X zoom lens, an optical viewfinder and offers you the freedom to frame subjects exactly as you prefer, from all angles. $280



*ist D

One of the world's smallest, lightest digital SLR camera bodies with an array of advanced functions and user-friendly features. Featured with an 18-35 lens, 6.1-megapixels, and the optional variety of interchangeable lenses. $1,700

PENTAX
Optio 33WR

Just add water for the latest in digital fun in rain, snow or at the beach. 3-megapixels and water resistant. $350

PENTAX
Optio 450

Big advancements in little with the 4-megapixels Optio450 digital camera. This little digital hosts a generous LCD monitor, a ten minute movie mode with sound, voice memo for images, panorama assist, full manual control and a 5X optical zoom. $500

The latest PENTAX digital camera line includes six advanced digital cameras including the water-resistant, 3-megapixels Optio33WR, a second generation Optio S4 with 4-megapixels, a more responsive 5-megapixels Optio555, an "all around" Optio33LF, the Optio450 with a variety of features and the long anticipated **ist* D digital SLR with 6.1-megapixels, an array of advanced functions and a variety of interchangeable lenses.

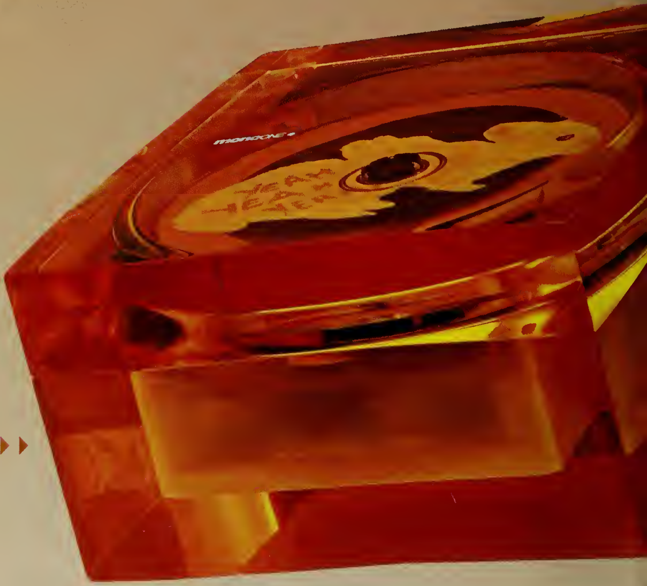
pentaxdigital.com

PENTAX™

HOUSE MUSIC

Yamaha's MusicCast is a self-contained groove network for the whole house. Its central hub rips CDs onto an 80-gig hard drive, then transmits tunes over Wi-Fi to up to five clients, each with its own remote. Connect clients to your stereo system, your kitchen boom box, even your spare PC speakers in the garage – and listen to your music archive anywhere you choose. An Ethernet port on the central server makes the system easy to connect to a home network to play streaming audio, too.

[**MusicCast:** $2,200 (plus $600 per client), *www.yamaha.com*]



JEWEL OF A CASE

Compact disc meets concept art in MonoOne's Hot Ice Cube, a translucent acrylic player that redefines cool. All its electronics are hidden beneath the disc tray, and a separate five-button IR controller keeps fingerprints from marring its diaphanous beauty. And you'll never forget what's in the player – you can just look.

[**Hot Ice Cube:** $256, *www.monoone.com*]

RELAY CHAMP

The JoyPort may look like an overpriced set-top, but it uses gold-plated output jacks, ultraclean audio circuitry, and 24-bit digital-to-analog converters to achieve sound quality that budget media streamers can't touch. Perch this unit atop your home entertainment center, install the included server software on your Linux, Mac, or Windows computer, and it becomes a wireless relay, playing your downloads, rips, or Internet radio sans tin-can computer sound.

[**JoyPort JP1R:** $1,298, *www.joyfaktory.com*]

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NOW, MORE ULTIMATE.

The exacting standards of the Bavarian Motor Works are legendary. So when their engineers were searching for a partner to integrate advanced digital systems into their entire line of cars, they turned to a company with an equally storied history of innovation—Harman International. For over 50 years, the brands of Harman International have been developing the industry's most advanced new technology. From the world's first factory-installed car stereo that brought hi-fi to the highway in 1948, to groundbreaking Harman Infotainment systems that bring up-to-the-second information and cutting-edge entertainment to your car in 2003. You can see the results of our most recent work in the remarkably intuitive onboard computer system of the BMW 5 Series. Harman engineering, combined with industry-standard MOST technology,

harman.com/infotainment

integrates the audio and navigation systems into one simple yet sophisticated interface – allowing you to access the complete range of in-vehicle services quickly and easily. Additionally, our voice-activated control system lets you manage all of these systems and talk on a cell phone, hands-free. And it all works side by side with one of the world's most breathtaking audio systems. A custom version of our Harman Kardon LOGIC 7® system that features 13 high-fidelity loudspeakers, Digital Dynamic Volume Control and multichannel surround sound for a uniquely rich, enveloping musical experience. So, with help from Harman Infotainment, the new BMW 5 Series is the ultimate driving, calling, heating, cooling, navigating and listening-to-incredible-music machine. To see what kind of superlatives we can add to your car, visit harman.com/infotainment.

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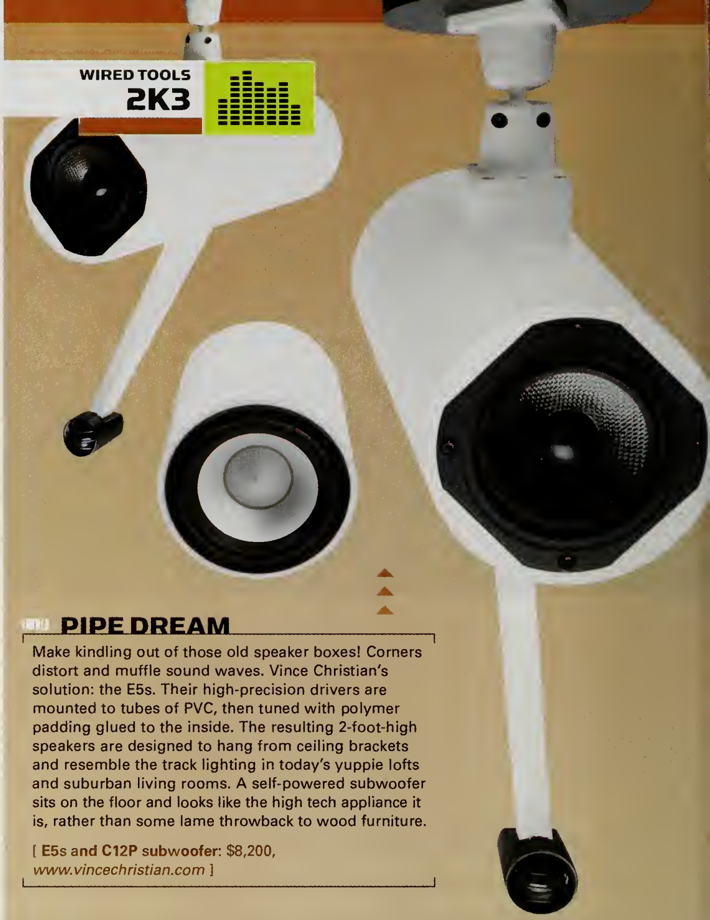

PIPE DREAM

Make kindling out of those old speaker boxes! Corners distort and muffle sound waves. Vince Christian's solution: the E5s. Their high-precision drivers are mounted to tubes of PVC, then tuned with polymer padding glued to the inside. The resulting 2-foot-high speakers are designed to hang from ceiling brackets and resemble the track lighting in today's yuppie lofts and suburban living rooms. A self-powered subwoofer sits on the floor and looks like the high tech appliance it is, rather than some lame throwback to wood furniture.

[**E5s and C12P subwoofer**: $8,200, *www.vincechristian.com*]

WI-HI-FI

Three words: Wi-Fi boom box. The Streamium MC-i250, Philips' high-end portable stereo, has a built-in 802.11b antenna that streams Internet radio from any open network to its 5.25-inch speakers. And when you're on the road, connect the box to your laptop with USB 2.0 and crank out MP3s from your hard drive. Perhaps in a nod to the Streamium's upmarket audience, its lines are so clean and simple, it takes the *ghetto* out of ghetto blaster.

[**MC-i250**: $800, *www.streamium.com*]

MP3 AMIGOS

You already jilted your walkman for an iPod. Why not abandon your Brobdingnagian home stereo, too? Creative's speakers hook up to any MP3 player to create a compact, 100-watt sound system with a central music library that unplugs for mobile listening. The system consists of three speakers: one subwoofer with a 6.5-inch driver, plus two desktop minitowers with drivers made of – what else? – titanium.

[**i-Trigue L3450**: $150, *www.creative.com*]

PLAY ANYTHING

Denon's universal disc player devours formats other players choke on. Pop in an SACD, DVD-Audio, DVD-Video, DVD-R, DVD-RW, CD, CD-R, CD-RW, or MP3 disc. Or peruse your JPEG, Kodak Picture CD, and Fujifilm Fujicolor CD files. The DVD-2900 plays them all. This new model has the same sturdy build and digital-to-analog converters as Denon's flagship player, but it loses the advanced audio-processing software. The pleasant surprise for cheapskates: It sounds a bit cleaner as a result.

[**DVD-2900**: $999, *www.usa.denon.com*]

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Unwire.

It's easy to keep up when your laptop isn't tethered to a phone jack. Free yourself at intel.com/unwire.

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DIGITAL DEPOT

The TheaterMaster is an all-purpose go-between for your audio components and amplifiers. Powered by 24-bit Burr-Brown converters, this digital surround processor translates up to eight channels of cold digital audio into rich analog. Take the coaxial or optical output of a CD, DVD, SACD, or DVD-Audio player and route it through this bad boy for ultrasuave decoding in almost any digital audio lingo – Reference Cinema, Cinema 7.1 Dolby Digital Surround EX, DTS ES, and Dolby Pro Logic II. Can it handle S-video? Composite video? Stereo subwoofers? Check, check, and double check.

[**TheaterMaster 8800**: $6,200, *www.alphadigitaltech.com*]

THE MINIMALIST

All the remastering in the world won't make that Kraftwerk CD reissue sound as good as the original vinyl. TecnoDec by J.A. Michell Engineering offers a supersleek entry to the world of audiophile turntables. The deck borrows only the necessary parts from Michell's time-tested, 30-year-old models. A superquiet DC motor drives the extra-heavy platter, which floats atop a new bearing design that pumps a thin layer of synthetic oil as it spins. Extravagant features, such as a casing and a dust cover, have been left out, giving the TecnoDec a striking minimalist look and a low price.

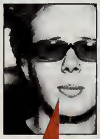
[**TecnoDec**: $1,795/$1,395 (with/without tonearm), *www.artech-electronics.com*]

TOTALLY TUBULAR

Vacuum tube amplifiers are still the né plus ultra for audiophiles who prefer overall range and dynamics to the block-rocking bass of transistor-powered models. The Monoblocks sport twin amps that power the left and right audio channels independently. With no shared wiring or even a volume knob, there's zero coloration of the signal traveling through each block. So what if it puts out only 9 watts per channel? Sit closer.

[**Heart Stoetkit II Mk II 300B Monoblocks**: $3,350, *www.fsaudioweb.com*]

Celebrity Stuff



"My use of technology is mainly in making music. I've got an iPod that's still in the box from when I bought it, and that was about a year ago."

TOM ROWLANDS

Musician and producer, Chemical Brothers

His Favorite Gear

[01] 1970s EMS Synthi-AKS portable synthesizer
[02] FinalScratch
[03] Apple Titanium PowerBook G4

His Wish List

"Abelton Live. It's a piece of software designed for the live electronic musician. Everything you do on the arrange page you can do on the fly – move chunks of audio around and speed it up and slow it down as you're playing. We're going to try to use that when we play live."

palm
POWERED

Meet the iQue 3600. The first PDA

with fully integrated GPS navigation .

The only PDA that comes complete with directions.

The Garmin iQue 3600 is a Palm-powered organizer and fully integrated GPS navigator. In addition to the traditional PDA functions of contacts, calendar and to-do lists, the iQue 3600 also helps you find restaurants, hotels, ATMs or street addresses with turn-by-turn directions to the door. It's just that easy. Visit your nearby electronics retailer or go online at ***www.garmin.com***. The iQue 3600 with GPS, mapping, voice recorder and MP3 player.

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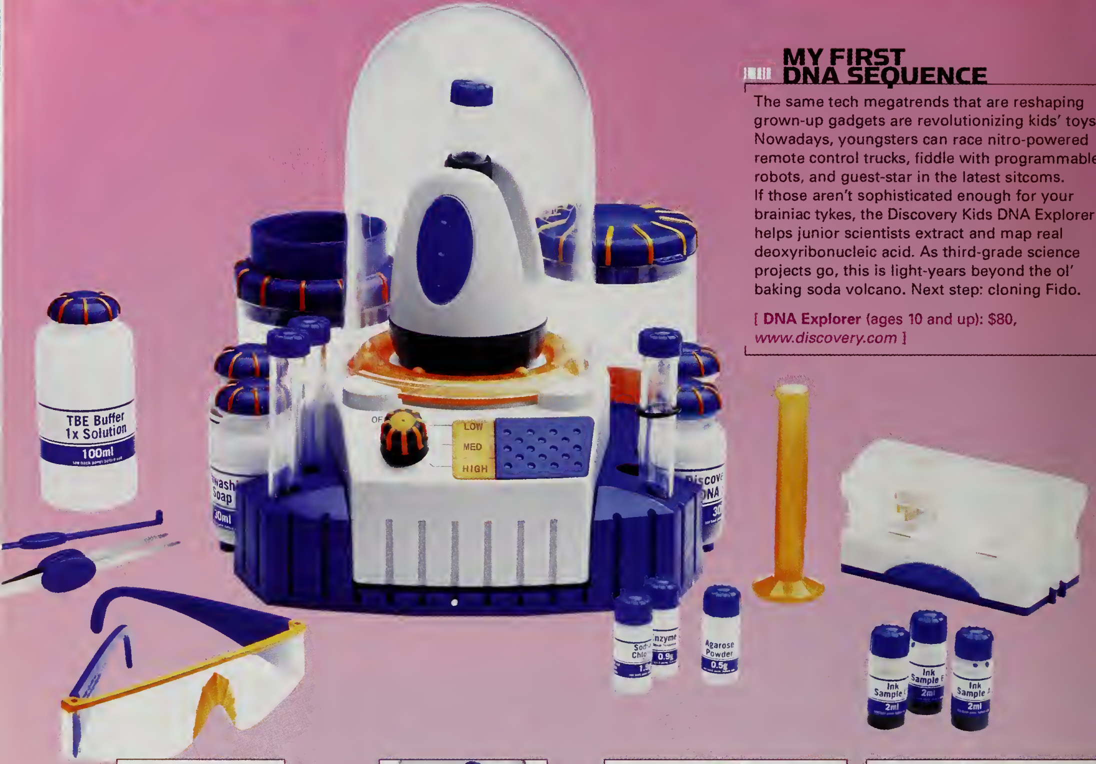
[TOYS]

by Chris Baker



MY FIRST DNA SEQUENCE

The same tech megatrends that are reshaping grown-up gadgets are revolutionizing kids' toys. Nowadays, youngsters can race nitro-powered remote control trucks, fiddle with programmable robots, and guest-star in the latest sitcoms. If those aren't sophisticated enough for your brainiac tykes, the Discovery Kids DNA Explorer helps junior scientists extract and map real deoxyribonucleic acid. As third-grade science projects go, this is light-years beyond the ol' baking soda volcano. Next step: cloning Fido.

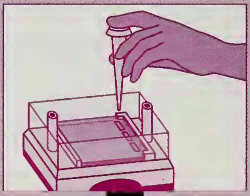
[**DNA Explorer** (ages 10 and up): $80, *www.discovery.com*]

▸ Prep the Specimen

Before extracting DNA, your young Dr. Frankenstein has to pick a specimen and prep it. The experiment works on all kinds of food, like corn, beans, or even (gross!) chicken liver. The kit includes freeze-dried ground peas (their DNA is easy to extract), isopropyl alcohol, and salt. When all three are put in a beaker and mixed with distilled water, the peas' cellular structure starts to break down.

▸ Separate the Oils

After transferring the mixture to a test tube, Dr. Frankenstein needs to add dish soap. The tube goes inside a splatter-proof magnetic mixer and centrifuge, which splits up the oils and separates the DNA from the soapy liquid. After 15 seconds, Dr. F stirs in a pinch of enzymes, adds alcohol, and the DNA strands float to the surface, where they can be harvested with the "DNA Hook."



▸ Zap the Molecules

To map the peas' DNA, Dr. F needs to whip up a sort of conductive Jell-O made from TBE buffer and agarose powder. The gel goes into a battery-operated electrophoresis chamber, where it's poked with a tool to make divots for the harvested genes. The molecules are transferred with a pipette. A zap of electricity sends the molecules – which are negatively charged – moving through the gel.

▸ Unravel the Mystery

A couple of hours later, Dr. F can add a few drops of stain (we recommend a sassy mauve tint) to expose the peas' – or any other – genetic blueprint. Watch your toothbrush: Frankenstein may figure out who Daddy really is (or isn't).

SUBARU OUTBACK®

The Symmetrical All-Wheel Drive System inside the Subaru Outback gives it the off-road capabilities of the toughest SUV. While the horizontally opposed boxer engine and lower center of gravity give Outback the handling and stability of a car. For a combination that buries the competition. **1-800-WANT-AWD.**

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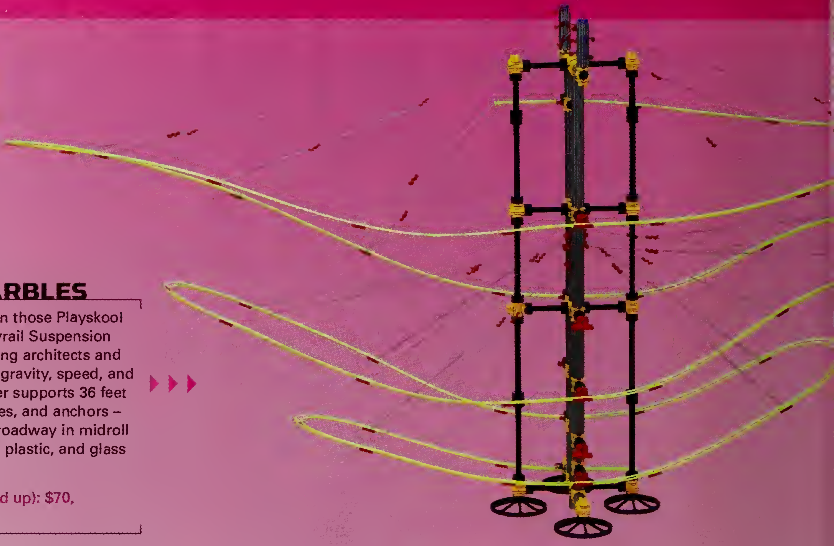
The ABC's of Safety: Air bags. Buckle up. Children in backseat.



MARVEL OF MARBLES

Remember rolling marbles down those Playskool ramps? Ho hum. Quercetti's Skyrail Suspension is an ultrasexy update for budding architects and engineers who like to play with gravity, speed, and inertia. A 3-foot-tall central tower supports 36 feet of track suspended by cables, ties, and anchors – just like a real bridge. Shift the roadway in midroll to fine-tune your descent. Steel, plastic, and glass marbles are included.

[**Skyrail Suspension** (ages 6 and up): $70, *www.intplay.com*]

GO, DIRT RACER, GO!

A 9-volt battery will get your remote-control SUV only so far. The XXX-NT Sport's oversize Mach 15 engine runs on gasoline – plus a dash of nitroglycerin for added kick. Best of all, it's ready to drive right out of the box. Just pop off the body, pour 2 ounces of fuel into the tank, and it's juiced for 5 minutes of 30-mph dirt racing. The fully tunable suspension system features anodized oil-filled shocks and coil springs, so the Sport can do crazy tricks without flipping over. The included remote has built-in memory to store precision moves for when you want to impress your friends.

[**XXX-NT Sport** (ages 12 and up): $500, *www.teamlosi.com*]

EXTREME THREE-WHEELER

You don't need a driver's license and a beat-up Toyota Corolla to perform spinouts, skids, and slides. Huffy's Green Machine features dual steering levers and rear-wheel turning for exquisite handling. The large rubber front tire grips the concrete, the hand brake lets you stop on a dime, and the extra-wide rear wheels give plenty of float for the perfect drift. Watch out, your kids might learn some tricks you don't want them to.

[**Green Machine** (ages 7 and up): $100, *www.huffybikes.com*]

The Fujifilm FinePix F700 Digital Camera

©2003 Fuji Photo Film U.S.A, Inc

Mr. Green's view

You won't miss a thing with Fujifilm's FinePix F700 Digital Camera. Just ask Mr. Green. Nothing captures youthful charm like the F700. With 6.2 million effective pixels, it delivers the most brilliant color pictures that challenge film. Fujifilm's patented Super CCD SR technology gives you the ability to capture fine detail in highlights as well as superb shadow detail and texture.

The picture Mr. Green takes is the picture he gets. For those constantly squirming targets, the F700's new continuous auto-focus mode means no shutter lag and the ability to never miss a shot. Which means that Mr. Green is taking the best pictures of his life. And the F700 comes with a PictureCradle for easy download to the computer. So he'll be able to share his masterpieces with family, friends, his boss....

The twins' view

For more information go to www.fujifilm.com or call 1-800-800-FUJI.

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Get the Picture

4th Generation Super CCD SR • Wide Dynamic Range • Compact Metal Body
Super EBC Fujinon 3x Optical Lens • Lithium-Ion Rechargeable Battery • Manual Shooting Capability

YOUR TICKET TO PLEASANTVILLE

Wish you could appear in the final episodes of *Friends*? The Star Video: Synthetic Reality System lets you insert yourself into any image onscreen. Plug the device into your television via a standard A/V jack, point it at a blank wall, and stand in front of it. Using the same blue-screen front-projection tech that superimposes meteorologists onto satellite images, the little cam puts you on prime time! Stroll through TV shows, home videos, DVDs, even pics from your PC. Groovy special effects let you go semitransparent, or turn black and white to hang with Bogart in *Casablanca*.

[**Star Video: Synthetic Reality System** (ages 8 and up): $160, *www.mgae.com*]

MR. ROBOTO

Its name sounds like a Polish porn flick, but WAO Kranius is a coder prodigy's R2-D2. The programmable bot has an 8-bit microprocessor and a built-in keyboard for typing instructions directly into the unit. Enter a command of up to 60 steps using its directional and numerical pad – hit Left, 2, and Enter, and your droid turns left at 45 degrees. Six vision sensors, like those on the Roomba vacuum, mean it can size up its surroundings to avoid falling off the counter, and if you place the four included light sensors on the floor, the little guy runs obstacle courses.

[**WAO Kranius** (ages 14 and up): $120, *robotikitsdirect.com*]

PULL MY TRIGGER

Why squirt fluid when you can break wind? This fun gun blasts a powerful pocket of air at unsuspecting victims up to 30 feet away. Just pull back Airzooka's elastic rear section, aim at your victim, and cut one – the shape of the barrel produces a concentrated vortex that's highly directional and doesn't break apart as quickly as a normal gust of air. Plus, it won't leave a trail of evidence like a water pistol.

[**Airzooka** (ages 8 and up): $13, *www.airzooka.com*]

Large color screen

Powerful Palm OS® V4.1 software

Phone/PDA with sleek, clamshell design

Verizon Wireless NationalAccess Capable KYOCERA 7135 Smartphone

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See www.verizonwireless.com/bestnetwork for network claim support. Network not available in all areas. ©2003 Verizon Wireless

CHANNELING DISNEY

Just give in. Disney controls the world, and you can't do a thing about it, so at least look stylish when you submit. This 13-inch color TV (engineered by Memorex), with Mickey-esque speaker ears and control panel, looks like a cross between an iMac and Mr. Toad's Wild Ride. It's cable-ready with 181 programmable channels and digital tuning. You can use it to watch non-Disney channels and movies – matching DVD player sold separately – but why in the world would you do that?

[**Disney 13-inch Color TV** (ages 6 and up): $120, plus $100 for DVD player, *www.disneyelectronics.com*]

GROSS ENCOUNTERS

The truth is in here. This deranged Kubrickian series pokes fun at the mythology and lore of aliens. Kids can spawn gruesome ETs by pouring bioplasm – which looks suspiciously like Play-Doh – into factory molds. The seven Alien Agency: The Arrival kits feature a selection of men in black, eggheads in lab coats, an operating table, and a scalpel and tweezers that let you stage your own autopsy.

[**Alien Agency: The Arrival** (ages 6 and up): $6-40, *www.megabloks.com*]

EASY RIDER

Can't afford a lift pass? Turn a wintertime backyard into your own snowskate park with Burton's Approach. Developed with Vermont locals and pro riders like Ben Connors and Tad Hukari, the Approach's one-piece design makes it light, stable, and easy to ride. Its two-level form gives riders enough leverage to turn and flip on hard or soft snow. Nailing that 360 on a makeshift half-pipe won't be a problem anymore.

[**Approach Snowdeck**: $80, *www.burton.com*]

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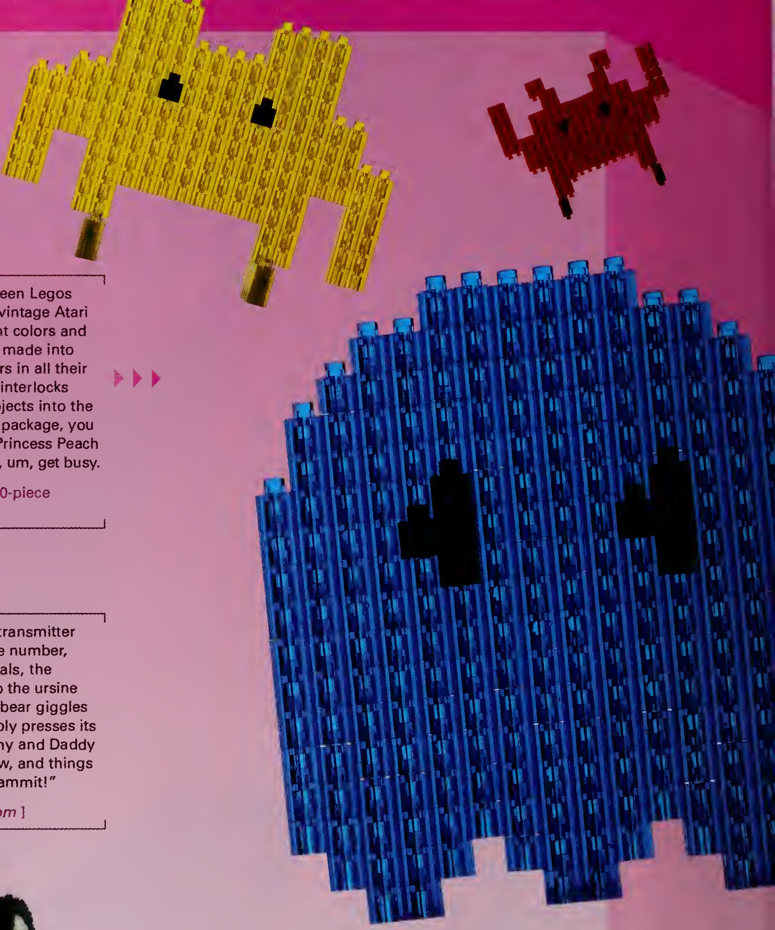
PEGAPIXELS

Kick it lo res. PixelBlocks are a cross between Legos and Lite Brite, with a generous helping of vintage Atari aesthetics thrown in. The bright translucent colors and sharp edges of these mini pegs beg to be made into chunky Pac-Man ghosts and Space Invaders in all their flat, old-school glory. Each building block interlocks on all six sides, so you can also render objects into the vertical plane. With up to 2,800 blocks per package, you can construct a 3-D honeymoon suite for Princess Peach and Mario so they can finally kick back and, um, get busy.

[**PixelBlocks** (ages 8 and up): $50 for 2,800-piece package, *www.pixelblocks.com*]

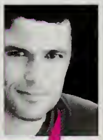


MOMMY'S LITTLE MOUTHPIECE

Teddy Ruxpin goes wireless. Plug Wabi's transmitter into a phone jack, call a designated toll-free number, and record a message. At selected intervals, the transmitter collects the data and sends it to the ursine bot's receiver over a 900-MHz signal. The bear giggles when it gets a message, and your kid simply presses its badge to play the audio. "Hi, Billy! Mommy and Daddy don't love you anymore. I'm in charge now, and things are going to change around this house, dammit!"

[**Wabi** (ages 2 and up): $60, *www.wabi.com*]

Celebrity Stuff



"I'm a watch freak. Guys love gadgets on watches. Well, at least I do."

CARLOS BERNARD

Actor, Fox TV's *24*

His Favorite Gear

[01] **Vintage Mickey Mouse pocket watch**
[02] Apple PowerMac G3 (with Macromedia Flash to personalize his Web site)
[03] Maurice Lacroix Globe watch with chronograph

His Wish List

"The new PowerBook laptop. It would be fantastic if someone left that under the tree for me."

PHILIPS

Let's make things better

"I'll never forget the look on my mother's face the day I was born."

You've watched those videotapes so often, you're concerned they'll wear out. With a Philips DVD Recorder you can relive your favorite memories as long as you live. Simply link it to your VCR, camcorder or television to record a DVD you can play most anywhere, anytime. Your memories will always look just as you remember them. Maybe even better. **Remember more with the Philips DVD Recorder.**

Learn more about preserving your precious memories at www.dvdrecorder.philips.com.

The Philips DVD Recorder

Capture and transfer your memories to DVD from any source – VCR, camcorder or TV.

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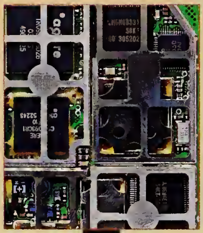
[POCKET TECH]

by Seth Feman and Paul Spinrad

CALLING ALL GAMERS

First it was smartphones, then phonecams – now gamephones are here to help you procrastinate. It was just a matter of time before games took advantage of the graphics, speed, and sound of next-gen cell phones. Leading the way is NEC's 515 High Definition Mobile, where 3-D space adventures are kicking *Snake*'s blocky ass.

[**NEC 515 High Definition Mobile:** $200-300, *www.nechdm.com*]



▸ Dual CPUs

Say good-bye to the herky-jerky graphics of single-chip phones. The 515 has a second processor for running games, so titles play smoothly without draining the battery. Software controls vibration feedback and enables simultaneous key pressing for combo moves (like advancing your character and gunning down monsters at the same time).

▸ Audio Chip

NEC teamed up with music maestro Yamaha to pump depth into its sound, for games and polyphonic ring tones. The new audio chip uses a high-resolution FM synthesizer, so when you start blowing things up, you'll forget you're listening to a mere 40 notes of sound.

▸ Color Screen

Most phone displays pale out with a scant 4,000 colors; this LCD supports 65,536, producing lifelike shades. Mobile games such as *Star Diversion* and *Baseball* – the first of dozens of DoCoMo Java titles available for download from NEC's site – look amazing on the 2.2-inch display.

▸ Quad-Band

Eventually, you'll probably want to make some calls. Working on four (yeah, four!) GSM frequencies instead of the standard two, the 515 is the first phone to deliver cellular access just about anywhere in the world. A single GPRS band makes for speedy data transfer, so you can stay connected via email, the Web, and text messages.

▸ Caller LEDs

Glitzy cell extras are usually just for show, but the seven-color minilight on the 515's top cover serves as an encoded caller ID. Assign each hue to a different number – red for the office, green for the spouse, et cetera – so you know when to pick up and when to play on.

► THERE'S DIGITAL.

►► THEN THERE'S CANON DIGITAL.

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DIGIC. A digital brain that brings you colors, light and detail as you see them. Especially combined with our legendary optics. We just thought it was the smart thing to do.

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Canon KNOW HOW®

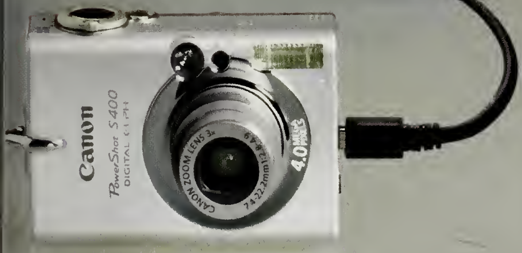
Digital Revolutionized fo

CARD PHOTO PRINTER CP-300

Style, meet convenience. The new Canon Card Photo Printer CP-300 is sleek, compact, and mobile. Easy to use, it has been thoughtfully designed to complement any room in your house. The trim lines and compact design make it right at home in a living room, den, study or anywhere else you want to print beautiful pictures. When you are on the go, use the portable battery to print crisp, high-quality prints – including postcards, wallet-size, and mini-labels – without a computer.

Your Lifestyle

Vhether you are at home or on the road, Canon has revolutionized ligital photography to suit your needs. Now you can print on the go! Iltra-light and compact, the new Canon Card Photo Printer CP-300 was nade for the things you do and the places you go. Just connect to the atest, stylish Canon PowerShot digital cameras, and in 85 seconds* 'ou can produce crisp 4"x 6" color prints without a computer. You'll get xceptional quality thanks to Canon's exclusive DIGIC Image Processor. nd with its increased processing speed, the colors you see are the nes you get. Did someone say revolution?



Canon
PowerShot S400
DIGITAL ELPH

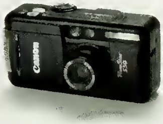
Elegance, meet power. The PowerShot S400 Digital ELPH camera has a stylish two-tone metallic exterior that is complemented by 4.0 Megapixels, a 3x Optical Zoom lens and a number of advanced features. Take it anywhere, it's ready to go!

Canon
PowerShot A80
DIGITAL CAMERA

- Exquisitely compact, simple to operate, and advanced shooting features — yet remarkably affordable
- New Vari-Angle Swivel LCD panel
- 4 Megapixels, 3x Optical Zoom

Canon
PowerShot G5
DIGITAL CAMERA

- Professional features with a stunning combination of resolution, speed, and control — all housed in a rugged, elegant new black enclosure
- 12 EOS-based shooting modes and a host of manual controls, advanced features, and optional Speedlite and auxiliary lenses
- 5 Megapixels, 4x Optical Zoom



Canon
PowerShot S50
DIGITAL CAMERA

- A host of options and all the features you could ask for
- Sophisticated, compact, brushed aluminum alloy exterior
- 5 Megapixels, 3x Optical Zoom

Get a free carrying case by mail when you buy a Canon Card Photo Printer CP-200 or CP-300! Offer valid on purchases made between 11/1/03 and 1/31/04. Go to powershot.com for details.

powershot.com

Canon KNOW HOW®

*Print speed based on average output speed achieved during product testing with Canon PowerShot digital cameras. Other manufacturers' products' print speed may vary. ©2003 Canon U.S.A., Inc. Canon, Canon Know How, PowerShot and ELPH are registered trademarks and DIGIC is a trademark of Canon Inc. Viewscreen and printer output simulated.

Canon
KNOW HOW®

Turn a wedding hall into a photo lab with the new Canon Card Photo Printer. Simply connect your PowerShot digital camera to a CP-200 or CP-300 and get great prints in 85 seconds. It even works with any PictBridge compatible digital camera.*

digital REVOLUTIONIZED photography ■ we REVOLUTIONIZED digital™

*Print speed [illegible] output speed achieved during product testing with Canon PowerShot digital cameras. Other manufacturers' [illegible] ©2003 Canon U.S.A., Inc. Canon, Canon Know How and PowerShot are registered trademarks and [illegible] digital [illegible] of Canon Inc. Images simulated.

I WANT MY *MTV

Boost your pop savvy with the Kyocera V5 cell phone. Select the hot button for direct access to the music networks' mobile entertainment Web site, *MTV. You'll be able to download Britney Spears trivia games and Good Charlotte ring tones and wallpapers and receive daily Gen Y news updates. Once you're in the know, slide out the phone's hidden dialpad to text-vote for your favorite video on *TRL*.

[**Slider series V5:** $159, *www.kyocera-wireless.com*]

PHONOGENIC

Lo-res phonecam pics are fine for swapping with other mobiles, but don't even think about displaying them on a proper PC screen or printing them out. Fortunately, a new generation of higher-res phonecams is coming, including Samsung's SPH-a600, which can shoot at 640 x 480. Onboard photo-editing software allows you to sepia-tone your image, make it a negative, or play with fluorescent and tungsten lighting effects directly on the celly. As if that's not enough, the a600 has a built-in flash, 4X digital zoom, photo caller ID, and can also capture lo-res (160 x 120 or 320 x 240) images.

[**SPH-a600:** $350, *www.samsung.com*]

BOOKMARK THE NEW BENCHMARK. www.acura.com/thenewtl

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NET ADDICT

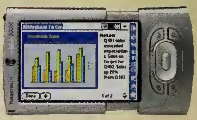
If you absolutely, positively won't use a smartphone, Sony's Clié PEG-UX50 PDA is the next best way to have email anywhere, with a pocket entertainment center thrown in for good measure. A built-in Wi-Fi sniffer alerts you when you've entered a wireless network. When you're out of range, the onboard Bluetooth links to your Web-enabled cell phone to keep you online. Offline, watch an MPEG-4 video on the massive 4.5-inch screen or chill out with some MP3s. (Both can be stored on the 29 Mbytes of media-dedicated internal memory or on, say, the new 1-Gbyte Memory Stick.) Or use the integrated digicam to shoot a 30-frames-per-second, 160 x 112-pixel home movie.

[**Clié PEG-UX50**: $700, plus $600 for 1-Gbyte Memory Stick, *www.sonystyle.com*]

RISE OF THE MACHINES

It took Warner Bros. a decade to make a sequel to *T2*, and it sucked. Palm took only a few months to develop the Tungsten T3 handheld, and it's full of awesome upgrades. Its 320 x 480 hi-res color screen can flip from portrait to landscape mode and boasts a 50 percent larger area than other Palms and twice the resolution of Pocket PC 2003 handhelds. Its 400-MHz processor and built-in Bluetooth allow you to wirelessly transmit data to a compatible device, like a projector. The advanced email system can send files of up to 5 Mbytes in one shot. Add a Wi-Fi SD card for a high-speed connection and it's "Hasta la vista, slow email."

[**Tungsten T3**: $399, *www.palmone.com*]



POCKET PC PHONE

Getting lost is so tired. Motorola's MPx200 with Windows Mobile Software sails through graphical apps and games originally designed for larger Pocket PC devices, like the animated Tube software that helps you navigate through the transit systems of a dozen major cities. This compact clamshell supports two GSM bands for voice and a pair of GPRS bands for email, SMS, and IM. Its 16-bit color screen displays streaming video and clips with desktop clarity. A full suite of smartphone apps lets you work, as well as play multimedia files and games, and the SDIO expansion slot can accommodate a digicam, additional memory, or other extras. Customize ring tones with any Windows Media sound file you care to upload, no matter how shocking or inappropriate.

[**MPx200**: $299, *www.motorola.com*]

INDUSTRY HEAVY

The smartphone meets the phonecam. Hitachi's G1000 features a 180-degree rotating camera that can snap photos at regular, 2X, and 4X magnifications. Check out your shots on the mobile's 3.5-inch, 16-bit color display. If you get into a snag, the internal GPS chip enables E911 services. At 5.75 x 3.25 inches and 8.4 ounces, the G1000 is heftier than other phones, but it delivers more: voice dialing, photo caller ID, speakerphone, text messaging, jog wheel, Secure Digital/MultiMediaCard expansion port, and custom ring tones (which can be any WAV file). It's worth the weight.

[**G1000**: $649, *www.hitachi.com*]

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intel

Chat Bill Davids(M)
Me: La Table for dinner tonite?
Bill Davids: Need to chk w/ the client
Me: Call my mobile to confirm.
Bill Davids: Will do. See you at 18:30

QuickText 14 characters
See you there.

TREO'S TRIUMPH

The Palm OS-based Treo series has already proved that being best beats being first. With the Treo 600, Handspring continues to get it right. The new smartphone introduces a 640 x 480-pixel camera and a much faster processor (144 MHz, up from 33) that can run Palm OS 5 on its superbright and superbig screen. The keyboard's domed buttons are easy to read and feel, and the battery allows for up to six hours of talk. Perhaps most important, the 600's 2.4-inch width means it can share a pocket more gracefully than its wide-body predecessors ever could.

[**Treo 600:** $500, *www.handspring.com*]

CARD SHARK

Need a PDA that can jump onto any network? Flip open the Linux-based YP 3700 and pick a CompactFlash card. Connect to the nearest hot spot with an 802.11b card, or swap in a Bluetooth card to transfer data to enabled peripherals like projectors, printers, and other PDAs. The small thumb-pad makes it hard to type long emails, but the large 3.5-inch, 65,536-color LCD makes it easy to read them. If you'd rather talk, the YP connects to CDMA networks; when one isn't available, try a GPRS/GSM card.

[**YP 3700:** $499 (network cards sold separately), *www.yopy.com*]

+ Celebrity Stuff +

DONNY OSMOND

Musician, TV game/talk-show host

His Favorite Gear

[01] **BlackBerry 957 PDA**
[02] 20-inch flat-panel Apple Cinema Display
[03] Motorola V60 cell phone

His Wish List

"Another electric car. I love the hybrid technology. I've been driving a Prius for three years; I was the first one in Utah to get one. In fact, a Toyota executive had to forgo his Prius so I could get it! I stole it from him!"

"I'm a gadget geek. When you're sitting in a hotel and can get on the Internet and access files from your studio immediately, creative juices tend to flow a little bit more. I just wish I'd had this stuff 20 years ago."

Lighten Up.

It wasn't so long ago that if you wanted to bring your data with you, your hardware had to come too. Well, that's all in the past now thanks to the new SanDisk Cruzer™ Mini. At under half an ounce, the Cruzer Mini goes anywhere, and with up to 256MB of flash memory, it takes a lot with it. Hi-speed USB 2.0 compliant, SanDisk's Cruzer Mini lets you transfer data faster than ever before. And at less than 8mm thick, all it needs is a single USB slot. Just drag, drop, and go. It's all about convenience – no extra hardware, no worries.

So whether you're installing utilities or updating print drivers for the umpteenth time, you can take your files with you wherever you go – and you won't even need your dolly.

For more information on SanDisk Cruzer Mini, visit www.sandisk.com/wired

HI-SPEED CERTIFIED USB

SanDisk

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[DIGICAMS]

by Marty Katz

POINT, SHOOT, TRANSMIT

Speed is the watchword in digicams. Improved processors and faster shutters are obliterating the lags, hangovers, and delays that used to plague photographers who snap live action. Nikon's D2H is the pioneer – it's a high-end digital shooter that uses Wi-Fi for image relays at broadband speed. At 4.1 megapixels, the quality is good enough for pro sports photogs; of course, weekend warriors will also have fun with the D2H, zapping hi-res updates to Grandma right from little Becky's field hockey game.

[**D2H:** $3,999, plus $1,650 lens, *www.nikonusa.com*]

▸ Screen

A larger-than-usual 2.5-inch LCD encourages "chimping," the practice of reviewing your shots and admiring your handiwork with an "Ooh! Ooh!" The orientation sensor knows when you turn the camera to shoot a vertical pic, and the software automatically rotates the image when you view it later.

▸ Reaction Time

Even the sharpest shooters have trouble catching the instant of impact – but using the D2H is like spraying the big moment with an Uzi. It captures up to 40 shots at 8 frames per second. And while some digicams have a shutter lag of 200 milliseconds or more, the D2H responds an amazing 37 milliseconds after you pull the trigger.

▸ Flash

The optional SB-800 flash ($420) lets you brighten more, faster: Wirelessly adjust and trigger up to 24 auxiliary flashes to light complex studio or event shoots. When you change the SB-800's settings, the information is instantly communicated via infrared to the other lights.

▸ Wi-Fi Module

The inch-tall Wi-Fi module mounts under the D2H like a motor drive. Select a few images and send them all flying via 802.11b to your PC, your blog, or your editor overseas. Shoot it, ship it, and get shoutback, all without leaving your perfect vantage point.

▸ Remote Antenna

The stubby antenna on the Wi-Fi module unleashes you for just 100 feet of roaming. If you need more space, tote the optional 8-inch-long whip antenna ($119) for a boosted 490-foot range. A Photo-fashionista headline for 2004: "ANTENNA HATS DE RIGUEUR FOR SIDELINE SPORTS PHOTOGS."

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Experience the purest, film-like quality in plasma TV.
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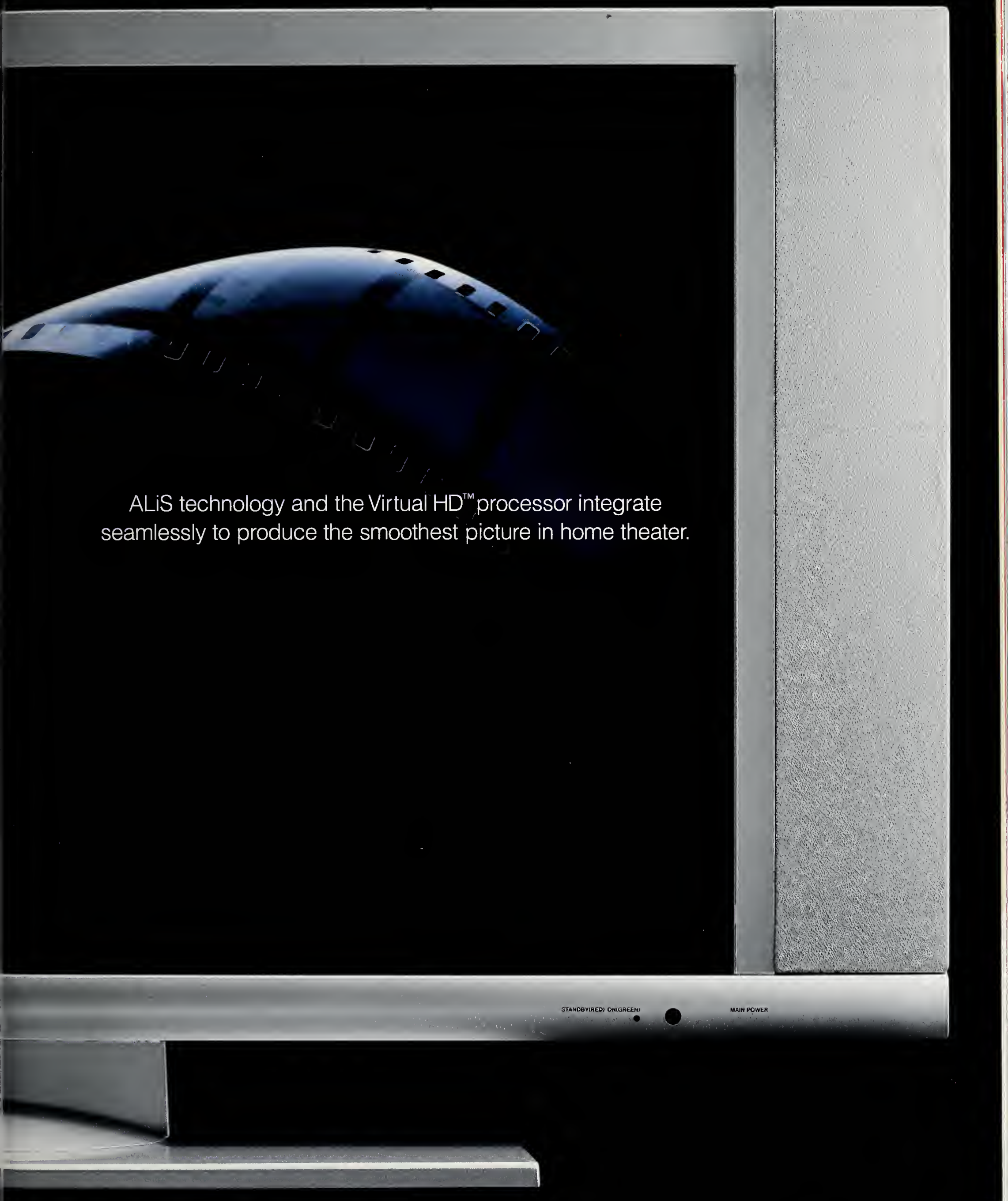
ULTRAVISION DIGITAL


ALiS technology and the Virtual HD™ processor integrate seamlessly to produce the smoothest picture in home theater.
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MAIN POWER

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Discover the beauty of the perfect plasma picture.
Original technologies, seamless integration. Only from Hitachi.
ULTRAVISION DIGITAL
HITACHI

Achieve the highest home theater experience possible with the Hitachi UltraVision Digital® Plasma TV. Original ALiS technology eliminates the "grid" pattern of conventional displays by using continuous vertical channels of phosphor. Integrated with the Virtual HD™ 1080p processor, Hitachi UltraVision Digital® plasma televisions display exceptional HDTV performance. A separate AV Control Center empowers users with an on-screen AV NET interface, which can run an entire home theater system from a single remote. Only the power of Hitachi original technology and seamless integration can deliver a stunningly film-like plasma picture for an unequalled home theater experience. Take a closer look at www.hitachi.us/tv.

ULTRAVISION
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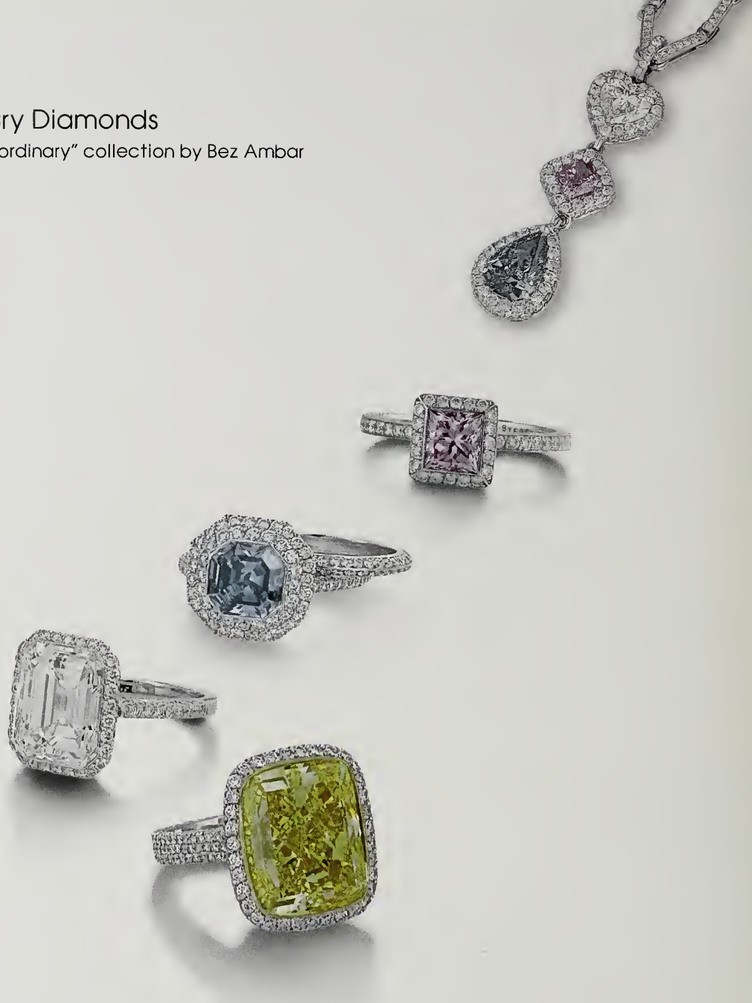

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SPLASH CAM

Neither rain, nor sleet, nor snow, nor mud will stop Pentax's Optio 33WR. The water-resistant cam is perfect for boaters, skiers, off-roaders, and butterfingers. The squared-off shooter has gasketed covers for connections and doors, and a Class 7 water-resistance rating. Translation: You can't take it snorkeling, but it should be OK if retrieved within a few minutes of dunking. It's no slouch as a camera, either – the Optio features a 2.8X internal zoom, a serviceable 3.2-megapixel sensor, and a slot for SD memory cards.

[**Optio 33WR**: $449, *www.pentaxusa.com*]

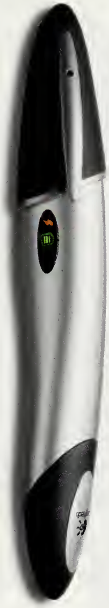
MICROMINI

Canon's 4-megapixel compact is about the size of a credit card (3.6 x 1.9 x 0.7 inches), and weighs only 3.5 ounces, so it slips easily into your shirt pocket. But it's so gorgeous that you'll want to put it on a chain and wear it. You can even color-coordinate – it's available in bronze, silver, black, and iridescent white. Though it's only got digital zoom, its fixed 39-mm lens is a fast f2.8 and has a field of view roughly comparable to the eye's. There's a quick-shot mode for reduced shutter lag and a super-macro mode for focusing down to 1.2 inches. The SD10 is powered by a rechargeable lithium-ion battery, uses SD media cards, and can print directly to Canon printers.

[**PowerShot SD10**: $449, *www.usa.canon.com*]

CAUTION

DON'T CHEW ON THE CAP. YOU MIGHT CRUSH THE OPTICAL SENSOR.



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With the first phone in the U.S. loaded with Windows® productivity.

Introducing the
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with Windows Mobile™ software.

Only from AT&T Wireless.

Here's the new Motorola MPx200, a slim, sleek smartphone that keeps you connected when you're out of the office.

With pocket versions of Microsoft® Outlook,® MSN™ Messenger, Internet Explorer,™ and Windows Media Player,™ you'll find familiar screens and easy navigation.

Quick and easy synchronization with your PC keeps you current with office or personal e-mail.

Manage your Microsoft Office inbox, calendar and contacts to stay productive while on the go.

It's a phone with a built-in PDA, voice dialing, speakerphone and an expanded memory slot.

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PLAY YOUR CARDS RIGHT

There are six competing media card formats out there. Here's how they stack up.

CompactFlash

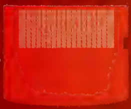
CF is slightly bulky – compare it to a matchbook – but it's the best-selling media card. It has the lowest price (about 25 cents per megabyte) and the highest capacity available (4.8 Gbytes and climbing). Some digicams feature a second slot for CF.

Memory Stick

Buyers of Sony (and some Samsung) devices were once locked into this proprietary format, which topped out at 128 Mbytes. This year, Sony introduced a new Memory Stick Pro standard that boosts capacity to 1 Gbyte. The company also capitulated to the popularity of CF with the DSC-F828 camera (page 162), which has slots for both cards.

Secure Digital

SD is the up-and-comer. It stores up to a gig on a card the size of a Wheat Thin, which pleases designers of compact cams, phonecams, and PDAs. SD costs about 35 cents per megabyte, and capacities are increasing.



Extreme Digital

XD is slightly smaller than SD, but it tops out at 512 Mbytes. And XD only works in Olympus and Fuji cameras.

SmartMedia

Stamp-sized SM cards are the thinnest of the bunch, but they hit a capacity cap at 128 Mbytes.

MultiMediaCards

MMCs aren't yet a factor in digital photography but will be used in upcoming Nokia phones.

SEE-THROUGH SCANNER

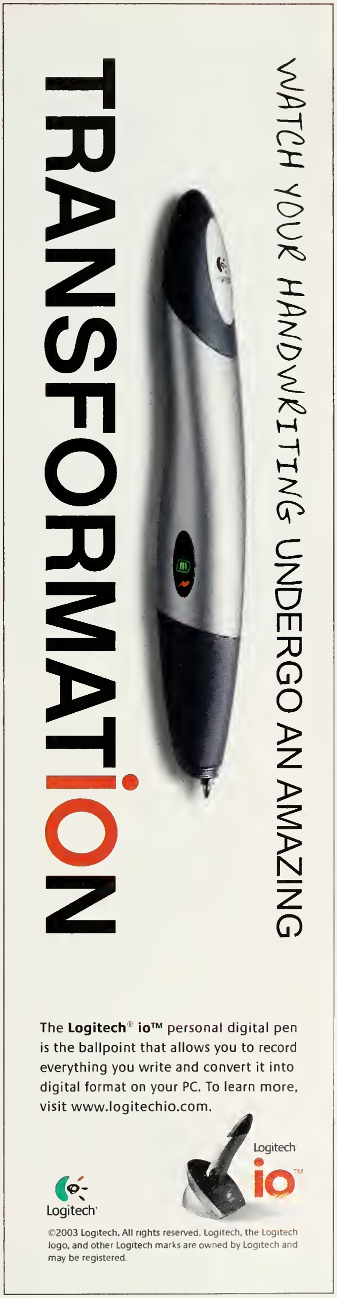
It looks like a picture frame, but HP's Scanjet 4670 is the quintessence of handy scanning. Scan-head miniaturization has shrunk the guts wafer-thin, so only the polycarbonate body is visible. It sits vertically in a holder for a slim 16.3 x 7.1-inch footprint, and the 2,400-dpi resolution and 48-bit color depth mean professional-quality image capture. Photos, books, slides, and negatives – this baby scans whatever you lay it on, or on it. Pranksters, don't limit yourself to butt scans; new body parts are now accessible.

[**Scanjet 4670**: $199, *www.hp.com*]

ONE-STOP PHOTO SHOP

The Photosmart 7960 is ingenious. Slots for most camera formats and a 2.5-inch LCD let you print images without firing up your PC or Mac. Front-panel controls and features like automatic red-eye removal make it easy to optimize and edit images. The HP's 4,800-dpi output guarantees exquisitely detailed color or black-and-white photos suitable for framing. You'll love the interactive contact-sheet feature: Print the thumbnail index of your images, select the keepers and choose their sizes, then feed the index back in; the 7960 magically reads and fills your order.

[**Photosmart 7960 Printer**: $299, *www.hp.com*]



The **Logitech**® **io**™ personal digital pen is the ballpoint that allows you to record everything you write and convert it into digital format on your PC. To learn more, visit www.logitechio.com.

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NIGHT STALKER

Sony's DSLR is a hefty 2-plus pounds, but it's feature-rich: Its 8-megapixel sensor sees in four colors rather than the usual three, which improves rendition under a variety of lighting conditions. With its extended infrared sensitivity, the F828 can be used as a night-vision camera – in a dark room, it bathes the subject in IR light, letting you see it clearly through the electronic viewfinder. The lens isn't interchangeable but it's a versatile 28-to-280-mm zoom. Its wide aperture and sensitivity of up to ISO 800 allow fast shutter speeds for sharpness. Best of all, Sony no longer forces you to use its Memory Stick – there's a slot for CF memory, too.

[**DSC-F828 Cyber-shot:** $1,200, *www.sonystyle.com*]

MUST-HAVE ACCESSORIES FOR CAMERA FIENDS

Grandmaster Flash

It's the ultimate portable field archive/display gizmo. This battery-powered, Linux-based device copies images from a CF card (and other media with adapters) to a 40-gig internal hard drive. A 3.5-inch LCD and file browser allow viewing and editing of images. The FlashTrax, which connects to a PC via USB 2.0 as an external drive, can run a slide show on TV and even play MP3s and MPEGs. **FlashTrax FTX40:** $499, *www.smartdisk.com*

Armored Picture Carrier

Whether you're documenting a war zone or a family reunion, you want a sturdy backup storage device for your pics. The Fortress is nickel-plated aircraft aluminum machined into a curvy shell. The soft, rubbery interior protects the 80-Gbyte hard drive from vibration and shock – it's rated to survive a 6-foot drop onto concrete. **Fortress:** $799, *www.4tress.com*

Ample Archive

The pixel counts in pictures are rising rapidly. Luckily, so is the amount of memory crammed onto tiny CF cards. This little SanDisk unit has nearly the storage capacity of a single-density DVD – it holds about 2,500 1.6-Mbyte JPEGs. Now you can save – or lose – a lot more images at once. **4.0GB CF card:** $999, *www.sandisk.com*

I'll Lumbar 4 Ya

Heavy camera gear goes unnoticed when held up by the hips and not the back muscles. That's why shutterbugs adore the Tour. This sturdy ripstop nylon lumbar pack socks away 660 cubic inches of cameras and accessories. Everything is well thought out, from the 5.5-inch-wide padded belt and multiple attachment points to the detachable shoulder strap and briefcase handles. **Tour Pack:** $70, *www.mountainsmith.com*

Diffuse Box

Next time you're shipping something, grab a few extra boxes. They make a great hack for impromptu portraiture sessions. Point a bright external flash at a broken-down 27 x 28-inch FedEx box and bounce light onto your subjects like the pros do with their fancy softbox and strobe systems. The white-coated surface of the box offers the perfect level of shine, and the little bit of orange lettering even warms the color up a touch. **Large FedEx Express box:** free

Dust Buster

A digicam's CCD sensor is a dust magnet, and you used to spend a lot of time and money shipping it off for a cleaning and overhaul. But this $3 rubber squeeze bulb renders factory technicians obsolete. A thin brass nozzle produces a high-velocity, precise whoosh (without canned air's propellant or the moisture of your breath) to lift away offending specks and motes. **Dust blower:** $3, *www.widgetsupply.com*

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Unfold the road map.
Head for the squiggliest lines.

There are roads out there just begging to be driven. And no SUV can oblige them like the Cayenne S. Permanent all-wheel drive. Porsche Stability Management. And exacting agility as ribbons of pavement unwind effortlessly before you. Porsche. There is no substitute.

The Cayenne S. Starting at $55,900.

PORSCHE

CINEMA SCOPE

If you own a hi-def TV and are sick of waiting for more HD content, why not make some of your own? HD video cameras have made the jump from bulky $70,000 professional tools to $3,500 consumer gadgets. JVC's 3.3-pound GR-HD1 grabs 30 frames of video per second at 720-line resolution on standard miniDV discs. A 200X digital zoom with optical image stabilization means you can zero in with pinpoint precision, and the 3.5-inch LCD makes it easy to review your shots in the field. Budding Spielbergs will jump at the chance to make high-quality digifilms, and new parents can produce "baby's first" movies that will still look sharp years from now.

[**GR-HD1**: $3,500, *www.jvc.com*]

CROWD PLEASER

Compact digicams aim for perfection, but they usually fall short: too slow on the snap, too pricey, too lo-res, lame lens. Olympus's beautiful compact camera shows what's possible, especially with speed. The quick shutter response, short shot-to-shot prep time, and a wide-angle zoom (4X, 27 to 110 mm) make rapid-fire snapping easy. It runs on standard AA batteries and accepts both CF and XD memory cards. The agile flip-up screen and advanced processing algorithms make for a stylish, pocketable 5.1-megapixel cam that beginners will love and experts may consider.

[**C-5060 Wide Zoom**: $699, *www.olympusamerica.com*]

Celebrity Stuff

BOB BURNQUIST

Pro skateboarder, 2003 X Games gold medalist

His Favorite Gear

[01] Casio EX-M2 digital camera
[02] T-Mobile Color Sidekick
[03] Palm m505
[04] Samsung V205 cell phone

His Wish List

"The new iPod. And I want to extend my wireless network with the Airport Extreme base station."

"I travel around a lot, so these gadgets are a lifesaver for me. I couldn't do what I do and have everything that I have going on without them."

SONY

Sony recommends Microsoft® Windows®
XP Professional for Mobile Computing.

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The Sony VAIO® TR series notebook maximizes your mobility in style. Enjoy wireless mobility and freedom. Watch your favorite DVD movies. Easily capture and share images with a built-in digital camera. Burn and listen to your own CDs. Unleash your creativity and experience endless possibilities.

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Sony VAIO® PCG-TR1A Notebook
–August 2003

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  - Integrated Wireless LAN: Intel® PRD/Wireless Network Connection 802.11b[18]
  - Intel® 855 Chipset
- Microsoft® Windows® XP Home Edition
- 60GB Hard Drive[2]
- 14" SXGA+ TFT display
- 512MB DDR SDRAM
- Integrated CD-RW/DVD Combo Drive[4]
- Amazing battery life up to 6.5 hours[9]
- Integrated Bluetooth™ Wireless Technology[10]
- USB 2.0
- Stylish and sophisticated design in a 4.7lb.-light[5] and 0.9–1.5"-thin body
- Included software: PictureGear Studio,™ SonicStage,™ DVgate Plus™
- 1-Year Limited Warranty[3]

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$2,199 As low as $55 per month for qualified customers.[13]

UPGRAOES
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- Sony VAIO® Double-Capacity Lithium Ion Battery[9] for $499.99

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  - Integrated Wireless LAN: Intel® PRD/Wireless Network Connection 802.11b[18]
  - Intel® 855 Chipset
- Microsoft® Windows® XP Home Edition
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- 12.1" XGA TFT display
- 256MB RAM
- Integrated CD-RW/DVD Combo Drive[4]
- VAIO Creation Suite Standard software package
- 1-Year Limited Warranty[3]

$\$1{,}799^{99}$ As low as $45 per month for qualified customers.[13]

UPGRAOES
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- Double-Capacity Battery[9] for $200

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  - Intel® 855 Chipset
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MSX-M256A Memory Stick PRO Duo™ Media[11]

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RS Series
The Affordable Entertainment PC

PCV-RS400C—Display sold separately
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- 256MB DDR at 266MHz
- DVD+-RW Drive[4]
- 64MB Intel® 845GV Integrated Graphics
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- VAID Creation Suite Standard software package
- 1-Year Limited Warranty[3]

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UPGRADES
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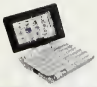

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V Series
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- Microsoft® Windows® XP Home Edition
- 80GB Hard Drive[2] (7200 rpm)
- 512MB DDR at 333MHz
- CD-RW/DVD-ROM Combo Drive[4]
- 15" LCD display
- Wireless keyboard & mouse
- Built-in stereo speakers
- Giga Pocket® Personal Video Recorder
- 1-Year Limited Warranty[3]

$1,599.99 As low as $40 per month for qualified customers.[11]

Display sold separately

RZ Series
The Ultimate Entertainment PC

PCV-RZ40CG—Display sold separately
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- Microsoft® Windows® XP Media Center Edition
- 160GB Hard Drive[2] (7200 rpm)
- 1GB DDR at 400MHz
- DVD±RW/DVD-ROM Drives[4]
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- 1-Year Limited Warranty[3]

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DVD Handycam®
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Digital Still Camera

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"PC *Magazine* readers give Sony VAIO® desktops an 'A' for Overall Desktop Satisfaction."
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[DVD + DVR]

by Brian Lam

MOVIE MOGUL

Digital video is exploding. People are burning it, P2Ping it, streaming it, stockpiling it, even toting it around. That means massive headaches for the MPAA and TV networks, and tons of fun for you. Even if you still own a VCR and it's flashing "12:00," you can upgrade to Video Valhalla in one stroke with the Pioneer Elite DVR-57H. It's the best combination media streamer, set-top box, and DVD burner around.

[**Elite DVR-57H**: $1,800, *www.pioneerelectronics.com*]

▸ Hard Drive

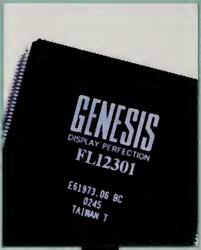
Able to store nearly an hour per gig on the lowest compression setting, this 120-Gbyte hard drive has enough space to hold all 14 seasons of *The Simpsons*, sans commercials. Or the next 200 years' worth of Super Bowl commercials, sans the Super Bowls.

▸ DVD Burner

Back up your drive on DVD-Rs, which hold one to four hours of video with TiVo program guide descriptions. You can even watch shows from the hard drive while burning. Are soap operas your guilty pleasure? Use erasable DVD-RWs so you can destroy the evidence.

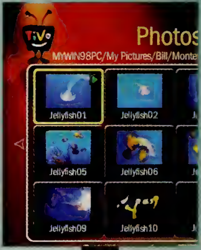
▸ Importing and Editing Features

Resurrect your old VHS tapes. The Elite records video directly from a VCR or camcorder to the hard drive. Its edit function lets you cut dull moments and obnoxious brothers-in-law. Burn to DVD so the rest of the family can enjoy your new-and-improved director's cut.



▸ Components

An image processor with de-interlacing technology allows crisp progressive-scan playback without jaggy artifacts. The chassis is double-layered to kill vibrations that might make the DVD skip. And the writer burns at 4X speed – an episode of *The Sopranos* takes 15 minutes.



▸ Built-in TiVo

With TiVo, you can start watching a show before it's finished recording, or record one while you're enjoying a DVD. Opt for the new home media service and this box will stream pictures and audio from your PC, plus share a show from your living room TiVo with the bedroom TiVo.

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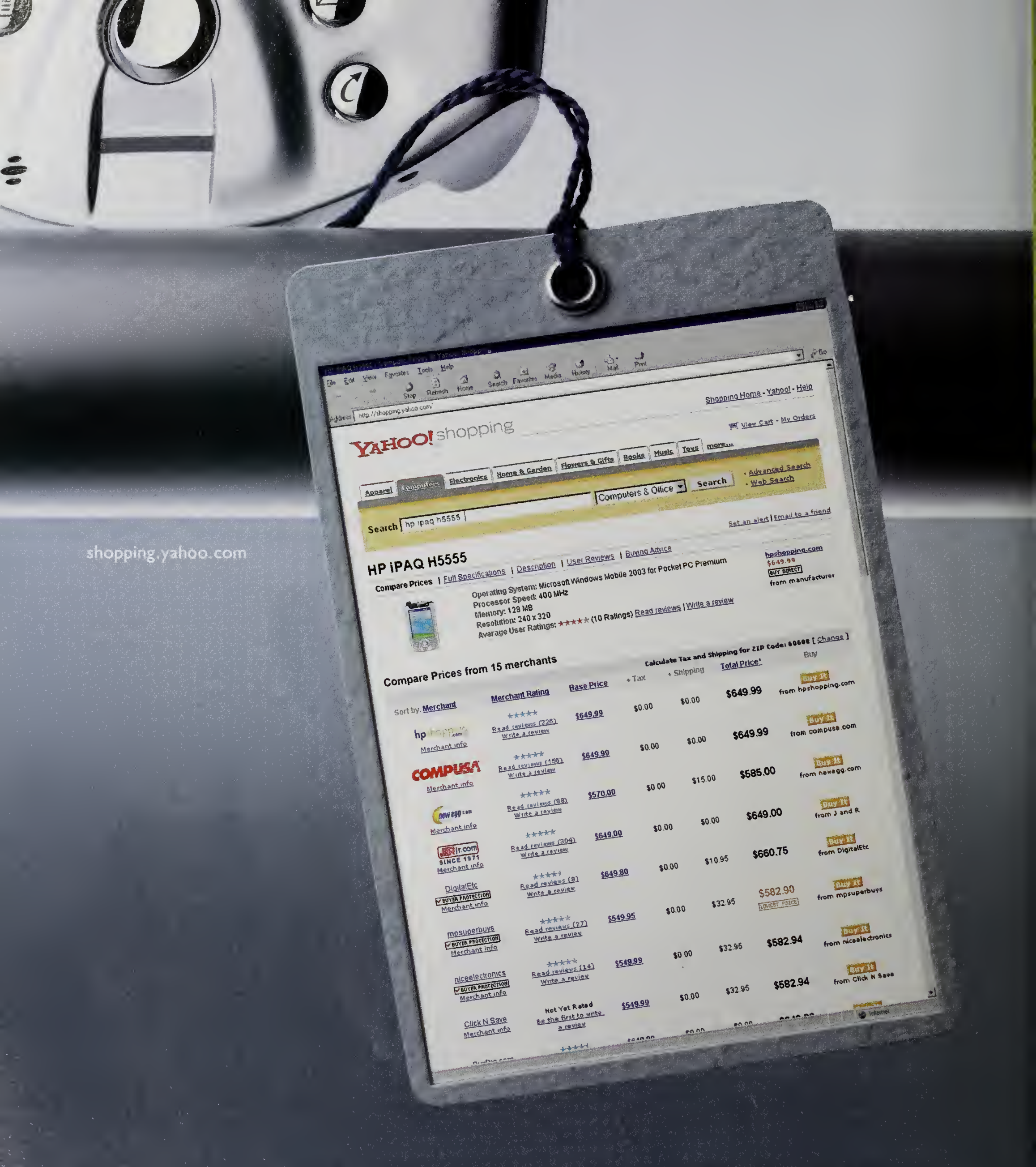
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164 Mountain Smith Tour Pac *mountainsmith.com*
164 Widget dust blower *widgetsupply.com*
170 JVC GR-HD1 camcorder *jvc.com*
170 Olympus C-5060 Wide Zoom *olympusamerica.com*

DVD and DVR

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179 Interact-TV media center *interact-tv.com*
180 Kiss DVD player *kiss-technology.com*
180 Plextor DVD burner *plextor.com*

Game Gear

182 Falcon Northwest gaming PC *falcon-new.com*
187 Intec controller *inteclink.com*
190 Nyko controller *nyko.com*
190 Cosmo wireless lightgun *cosmoacc.com*
190 RetroCon controller *madcatz.com*
189 Arcade PC Deluxe cabinet *hanaho.com*
189 Cobalt Flux dance pad *cobaltflux.com*
192 Zboard CrossFire keyboard *ideazon.com*
192 Sennheiser headset *sennheisercommunications.com*
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194 Swiftech PC heat sink *swiftnets.com*

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PORTABLE VIDEO PLAYERS:

LITTLE BIG SCREEN

Handheld *audio*? Yawn. That is so 2002. Bigger hard drives and sharper screens mean that portable *video* players are finally viable. RCA's new PVP has a bright, palm-filling 3.5-inch LCD and 20 gigs of space for up to 80 hours of compressed video. Transfer media from your PC or connect with an RCA jack to record from your DVD player or TV. Beyond video, LYRA also does duty as a JPEG viewer, an external USB 2.0 hard drive, and an MP3 player.

[**RD2780 LYRA Audio/Video Jukebox: $449,** *www.rca.com*]

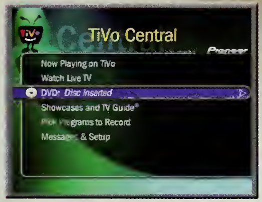
SIZING UP VIDEO PLAYERS FOR KIDS

Portable video players aren't just for gadget-happy adults. Three companies are vying to put PVPs in the hands of youngsters, so they can watch brain-rotting cartoons anywhere and everywhere. This holiday season will determine which company gains a stronghold – toy titan Hasbro, game software firm Majesco, or upstart startup HandHeld Entertainment. Here's *Wired*'s take on their specs and features:

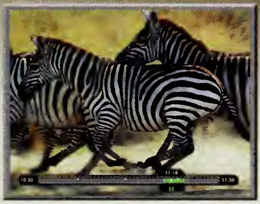
	HASBRO VIDEONOW	MAJESCO GAME BOY ADVANCE VIDEO PAK	HANDHELD ENTERTAINMENT ZVUE!
Color screen	No	Yes	Yes
Resolution (pixels)	80 x 80	240 x 160	234 x 160
Screen size	2"	2.9"	2.5"
Battery power	AAs	Lithium rechargeable	AAs
Media format	Proprietary minidiscs	Game Boy Advance cartridges	Rewritable SD cards
Program length	30 minutes	30 minutes, but compression may improve	6 to 30 minutes, but you can burn your own up to 16 hours
Content and licensing deals	Nickelodeon	None yet, but in talks with Warner Bros. and Disney	Extreme sports content from Teckademics, but more important, you can convert any PC video file
Price	$50 for unit, $8 for discs ($15 for 3-pack); *www.hasbro.com*	$100 for Game Boy Advance (sold separately), $20 for cartridges; *www.majescogames.com*	$99 for ZVUE!, $25 for 32-Mbyte card (30 minutes); *www.hheld.com*
Company clout	Hasbro's got the muscle to put its attractively priced player at eye level in Toys R Us and K-B Toys.	Majesco isn't a software heavyweight – it may not be able to break out of the games section.	ZVUE! was built by the guy who authored the MP3 codec, but it probably won't escape the consumer electronics ghetto.
Bottom line	Hasbro guessed right on HitClips, and we assume it's done its marketing homework on this unit. But we doubt kids will be satisfied with the small, grainy black-and-white versions of their favorite colorful cartoons, and by tying themselves to this piece of hardware, there's no room to improve picture quality down the line.	There are 23 million Game Boy Advance units out there, and Majesco is smart to piggyback on that robust install base. Cartridge format is more constrictive than discs or cards, but if Majesco's eggheads continue to improve compression rates, they could squeeze a whole 90-minute film onto one cartridge.	It took six years for Palm PDAs to dip below $100; it took just six months for PVPs to do the same. This looks like a solid option for brats in the backseat, and it should particularly attract Gen Y teens who don't want a kids' toy. Lots of crossover appeal for videophile grown-ups.

Pioneer *sound.vision.soul*

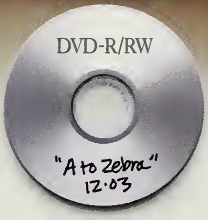
Ironically, a near empty entertainment center will now be the mark of a true home entertainment enthusiast.



FIND IT – With TiVo® service, you can search for, find and select individual programs. That way, you're in charge. So, no matter how busy you are, you'll never miss your favorite shows.



STORE IT – The 80-gigabyte hard drive provides you with up to 80 hours of temporary storage. So you can watch your shows whenever it's convenient. Plus, you can pause and replay live TV.



BURN IT – Programs on your hard drive can be burned onto your DVDs to create a library of your favorite shows, movies and sporting events that you can watch later on most standard DVD players.

Introducing the world's first DVD recorder with TiVo,® the Pioneer DVR-810H. Another one of our technologies that make a difference. To find a dealer near you, please visit **www.pioneerburner.com.**

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- 120GB (7200 RPM) IDE Hard Drive
- 4x DVD+RW/+R[5] with Sonic SE Professional Authoring Software
- NVIDIA QuadroFX 500 128MB AGP 8x Graphics Card
- Monitor Not Included

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HIGH-DEFINITION VIDEO PLAYERS:

PAUSE FOR CELEBRATION

Being able to pause and rewind live TV is cool; being able to pause and rewind HDTV is a revelation. LG Electronics' 120-Gbyte drive will hold 120 hours of standard TV or 12.5 hours of hi-def. And that 12.5 hours is truly deffer than def – visually sumptuous and luxuriously detailed, right down to the Dolby Digital audio. The built-in tuners can receive air and cable hi-def signals, as well as (ugh) dreary regular ones.

[**LG LST-3410A**: $999, *www.lgusa.com/dav*]

QUALITY CONTROL

Hi-def TV screens make a DVD's standard 480-line trickle look lo-res. Luckily, Samsung's DVD-HD931 converts video files into high-end formats like 720 progressive scan or 1,080 interlaced signals that will satisfy the most demanding HD sets and discerning viewer eyeballs. The rock-solid picture comes courtesy of a digital video port, which shoots a straight digital signal to your DVI-ready set, skipping rickety analog signals entirely.

[**DVD-HD931**: $349, *www.samsungusa.com*]

A PC FOR YOUR TV

It looks like a PC for your office, but it's meant for your living room. ViewSonic's M2100 runs Windows XP Media Center Edition 2004, an OS tailored to store and serve music, photos, and video. It can automatically rip MP3s every time you play a new CD, burn images to DVD, and record up to 140 hours of TV on its 160-Gbyte hard drive. It even has a remote control. We wish Media Center used conventional MPEG video encoding instead of the proprietary, uneditable DVR-MS, but at least the latest version lets you swap some video files with other Windows PCs.

[**M2100:** $1,599, *www.viewsonic.com*]

SLASH AND BURNER

The Linux-based Telly server does everything Media PCs can do – and adds features that make it a Hollywood exec's worst nightmare. It's compatible with video file formats that Microsoft won't touch, and it can serve all your TV and music across your network or even on the Internet. Would you rather watch that pirated DivX movie you downloaded to PC on your living room plasma? Drag and drop the file to the Telly. You can also move MPEG clips to your PC so you can cut the commercials out of that sitcom.

[**Telly MC1000:** $899, *www.interact-tv.com*]

The all-new 2004 XJ. Stronger. Faster. Safer. Smarter. It's the first time a luxury sedan has been built with an aluminum-intensive monocoque structure. This structure employs the same rivet-bonding technology found in aerospace construction. Together, they make for an XJ that is lightweight, yet structurally rigid. Fuel efficient,* yet agile. To learn more about the XJR's advanced aluminum body, visit jaguarusa.com/2004xj.

*XJ8 EPA-estimated 18 city/28 hwy mpg. XJR EPA-estimated 17 city/24 hwy mpg. ©2003 Jaguar Cars

JAGUAR

Born to perform

PIRATE TREASURE

DivX is the lean, mean video format preferred by Kazaa-philes. But why download a 600-Mbyte feature flick only to watch it on your puny computer monitor? Kiss Technology's DP-500 reads DivX encoded data from CDs and DVDs, and even streams it from your PC via Ethernet, so you can watch traded movies on your home theater rig. Although you won't get DVD quality, you will be sticking it to the man.

[**DP-500**: $299, *www.kiss-technology.com*]

SPEED FREAK

This high-speed drive is the Evel Knievel of DVD burners. The 8X writer can sear a DVD+R at 10 Mbytes a second, filling a disc in roughly seven minutes. As a bonus, it burns CDs at a respectable speed of 40X, or three minutes a disc. At that many RPMs, you run the risk of media spinning so fast that it literally explodes in the tray – but the Plextor's casing and bezel are reinforced to trap any shrapnel. Daredevils have more fun.

[**PX-708UF**: $359, *www.plextor.com*]

Celebrity Stuff

"I wish I was as gadget-oriented as my character [Marshall] on the show. I mean, I love it, but I'm not running around trying to find a pen that's also a camera."

KEVIN WEISMAN

Actor, *Alias*

His Favorite Gear

[01] Sony receiver for DirectTV with TiVo (60 hours)
[02] Canon PowerShot S1 digicam
[03] PS2 videogame console with *Tiger Woods Golf*

His Wish List

"I'm a big fan of all the Apple products. I take my iPod everywhere, and I just got the new iSight, which is the video chat eyes for Mac. I wish I had an iKitchen and an iButler to make me food in the morning."

When you need all-in-one multi-function convenience and all-in-one sleek design, you need the MFC-4420c.

No matter if your home office is a desk in the den, used for catching up with office projects and paying the bills, or an entire room in your basement used to run your new consulting business, our 4420c is the ideal all-in-one solution to your imaging and communications needs.

Of course that should come as no surprise when you realize it combines dazzling color printing, copying, and scanning, plus a fax, into a single all-in-one unit that's small on footprint, yet big on performance and style. Combine that with its ability to accept most popular digital media, and a flatbed design which makes copying and scanning books and bound documents simple, and you can see why the 4420c is what works for you.

Versatile flatbed makes scanning and copying simple!

Accepts most popular digital media without having to connect your camera.

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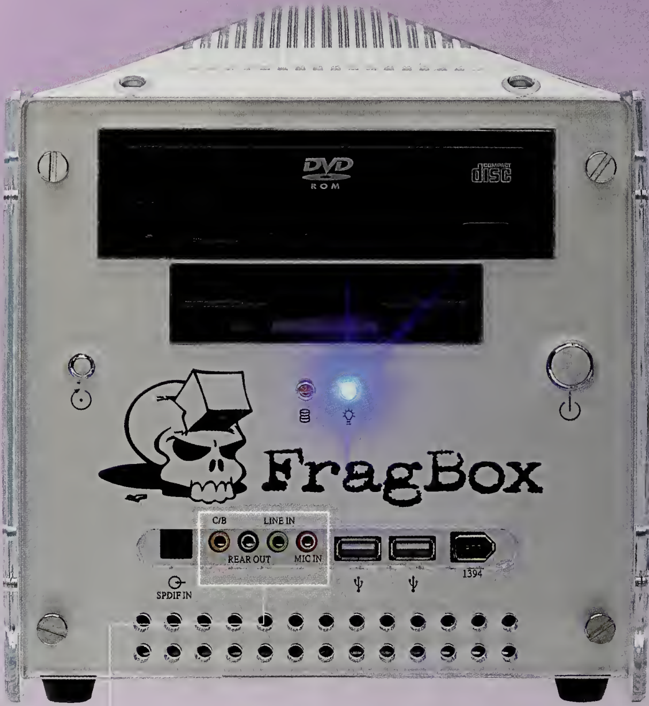
[GAME GEAR]

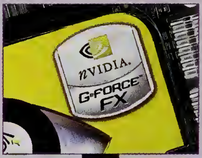
by Brian Lam and Will Tuttle



FRAG ROCKS

In all things PC, games lead the way. They push the industry to develop faster processors, bigger drives, lower latency, richer sound, better displays, and more intuitive interfaces. Though most high-end gamer rigs will empty your wallet and fill up your desk, Falcon Northwest's FragBox costs under a grand and mimicks the GameCube's footprint. It sets the stage for computers in 2004: Sexy, semiportable, and high-performance.

[**FragBox:** $995, *www.falcon-nw.com*]



▸ Front-Panel Jacks

The FragBox puts out 360 degrees of digital sound. At home, plug in your 5.1 speakers and you'll be able to pinpoint exactly where that soldier is lurking so he doesn't blindside you. At LAN parties, plug in your headphones to block out distractions. For team-based play, use the mike input to bark at your underlings.

▸ Tech Specs

Falcon's box has got guts. The high-performance hard disk spins at a whiplash-inducing 7,200 rpm. Its 80-Gbyte drive is large enough to hold three dozen games, plus a few dozen albums in MP3. It sports 512 Mbytes of RAM and a 2.7-GHz Pentium 4 processor, which is faster than the Xbox's CPU by a factor of three. Translation: Datawise, it hauls ass.

▸ Graphics Card

If the CPU is your PC's brain, then the graphics processing unit is its heart and soul. The FragBox's GeForce 5600 is a 256-bit, 128-Mbyte wonder, pushing pixels at rates that shame the Xbox. But the pace of innovation is so quick that graphics processors go stale in just months. Luckily, it's a snap to add a fresh, piping-hot videocard.

▸ Portable Design

You're going to that LAN party to lay down smack, not break your back. The FragBox is relatively light (14 pounds), and takes a cue from the GameCube, with a reinforced handle for easy transport. The tiny case (9.5 x 8.3 x 12 inches) leaves plenty of room on the table for wires, pizza boxes, and Red Bull cans.

▸ Bling-Bling

A high kill ratio will earn you respect, but so will a pimped-out PC with an evil skull logo. This is the next best thing to building your own. Peer through plexiglass panels at the FragBox's souped-up innards. Under the eerie glow of the heat sink lamp, its silicon and metal parts become a work of geek art.

On January 4, Stan Kutz found out that becoming an auto mechanic only requires one small tool.

When the "check engine" light came on in Stan's vehicle, he got a little nervous. But one push of the OnStar® button and an Advisor ran a GM® Goodwrench® diagnostic test on his vehicle — while Stan was driving! Within moments he got the good news: it was only a minor problem. From helping police locate a vehicle if it's stolen to sending a signal to unlock your doors if you lock your keys inside, OnStar helps drivers every day. So make sure to order your next vehicle with OnStar. To learn more, visit your dealer or onstar.com. If you're already an OnStar subscriber, it's easy to maintain the safety and security you already count on for only $16.95* a month. Simply press the blue OnStar button and tell the Advisor you'd like to renew.

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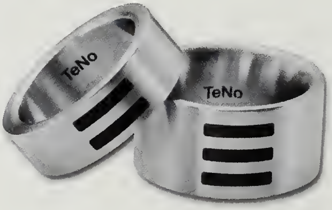

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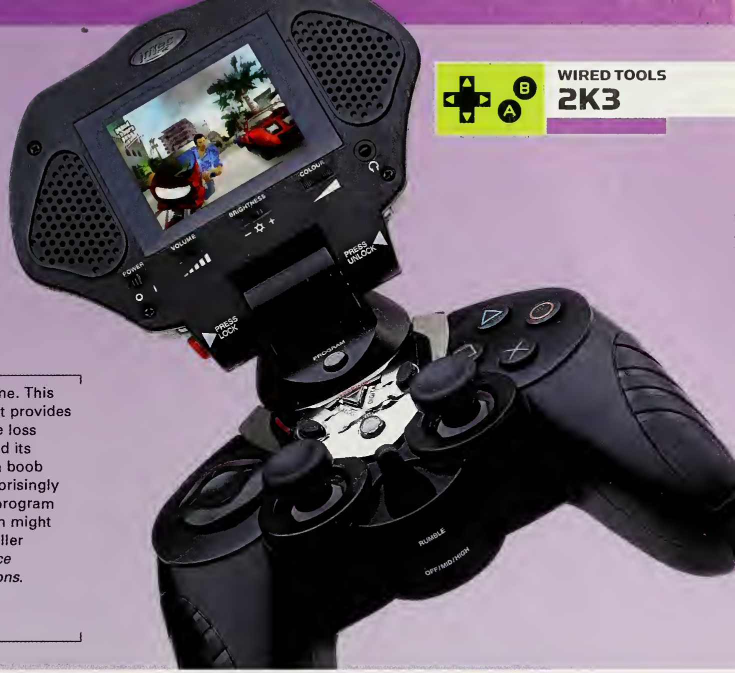

POP-UP VIDEO

Finally, gamers don't have to fight for TV time. This PS2 controller has a 2.5-inch TFT screen that provides sharp, clear graphics without an appreciable loss of detail. Plug the unit into your console (and its AC adapter into the wall) and play without a boob tube. Built-in stereo speakers produce a surprisingly powerful blast of sound. And the ability to program 16 move combinations into one macro button might make you give up your standard PS2 controller entirely. Now multitaskers can play *GTA: Vice City* without missing a minute of *The Simpsons*.

[**Intec Controller and Game Screen:** $99, *www.inteclink.com*]

INSET: COURTESY ROCKSTAR GAMES

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...keep it real.

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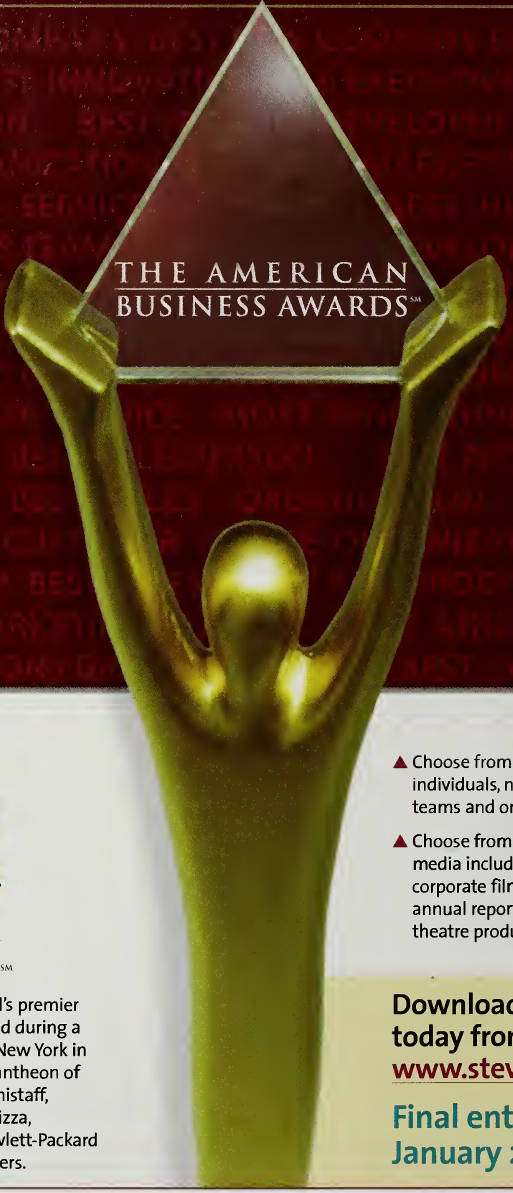

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YOUR OWN ARCADE

What some gamers wouldn't give to have an *Asteroids* cabinet in their living room. But wait: For five large, anyone can own this full-size arcade machine – and play thousands of vintage games, not just one. HanaHo's Arcade PC Deluxe packs a powerful computer into an upright 74 x 29 x 42-inch case, plus three joysticks, 20 buttons, and a trackball. The PC is preloaded with 50 classic Capcom titles, and you can download 7,500 other games (anything supported by MAME, or multiple arcade machine emulator). Best of all, you won't have to deal with surly teenagers wearing coin belts.

[**Arcade PC Deluxe**: $5,000, *www.hanaho.com*]

ENHANCE ENHANCE REVOLUTION

At last, an arcade-quality dance pad for your living room! *Dance Dance Revolution* fans can stomp all night on the Cobalt Flux Dance Platform. Constructed from top-of-the-line galvanized steel and shatterproof polycarbonate plastic, the inch-high platform has a weight capacity of more than 600 pounds, which the manufacturer tested by parking an SUV on it. Highly sensitive panels allow even the lightest hoofers to make a big impact.

[**Cobalt Flux**: $300, *www.cobaltflux.com*]

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PS2 PERIPHERALS:

KEYSTICK JOYBOARD

EverQuest Online addicts know there's nothing more annoying than having to put down the controller to type on the PS2 keyboard. That's why Nyko has given us the iType2. A mini-board is integrated into a standard analog PS2 controller so players can key in commands to teammates during battles without slowing down the action. The pen is no longer mightier than the sword – they're equals.

[**iType2 Controller**: $40, *www.nyko.com*]

UNWIRED FIREARM

Charles Bronson and Max Payne don't have cords trailing from their guns. Why should you? Cosmo's Radio Frequency Wireless Lightgun for the PS2 gives you the freedom to move around the room. Jump over your coffee table John Woo-style as you blast away baddies onscreen, without knocking stuff over with a cord. Coolest of all, when one of the three included battery packs starts to die, you can pop the "clip" out of the grip and slap in a new one, just like your favorite action hero.

[**RF Wireless Lightgun**: $40, *www.cosmoacc.com*]

RETRO ACTION

Few things evoke happy childhood memories like a warm mug of cocoa, a fuzzy blanket ... and an NES controller in your hand. Mad Catz created RetroCON for the PS2 with the nostalgic in mind. Its classically designed metal casing houses dual analog sticks and twin vibration motors. Extra-special bonus: The D-pad and buttons light up, which is comforting during long, dark nights of *Silent Hill 3*.

[**RetroCON**: $25, *www.madcatz.com*]

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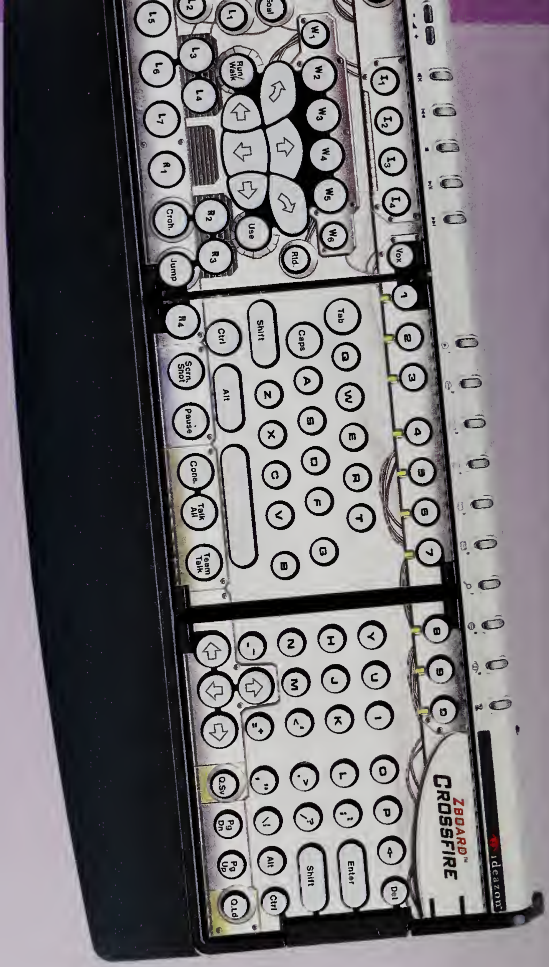
PC PERIPHERALS:

UNIVERSAL SOLDIER

Sometimes the difference between life and death onscreen comes down to a few accidental keystrokes. Fans of first-person shooters have long had to memorize hot keys unique to each game, and there's nothing more frustrating than dropping a grenade at your feet when you meant to crouch. Enter Ideazon's Zboard. Compatible with almost every shooter on the market, it features programmable, well-marked keys that are laid out for quick maneuvering. No more blaming the keyboard when you get fragged.

[**Zboard CrossFire:** $40 base bundle ($20 per additional keyset), *www.ideazon.com*]



COMM LINK

Whether you're tipping off troops or talking trash at opponents, headsets are a must for squad-based tactical shooters. The Sennheiser PC 150 puts you in the game without making you look like a telemarketer. The sleek, lightweight design and crystal-clear sound make the PC 150 essential for those endless bouts of *Counter-Strike*, while the comfy headband lets you forget you're wearing it. Most important, the noise-canceling mike will protect you from ridicule when you're getting chewed out for forgetting to take out the garbage.

[**PC 150:** $70, *www.sennheisercommunications.com*]

COLDFINGER

Keeping a cool head is important in first-person shooters, but not as important as keeping a cool hand. Nyko finally brings its popular Air Flo technology to the PC with the optical Air Flo Mouse, which has a built-in fan to push air through strategically placed pores in the rubber grips. Gamers can fire away for hours without stopping to wipe the sweat off their trigger fingers – or the mouse. Now if only they didn't have to get up for those pesky bathroom breaks.

[**Air Flo Mouse:** $40, *www.nyko.com*]

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Ketel One Citroen

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CPU COOLING DEVICES:

PC FREEZER

Until diamonds replace silicon, hardcore gamers will need CPU cooling devices to keep their overclocked rigs chilled out. The Mach II brings hot processors down to –58 degrees Fahrenheit. A powerful compressor creates a vacuum chamber, forcing refrigerants to evaporate and pulling heat from the CPU into an oversize radiator. Ironically, the cooling elements need to be surrounded by heaters to prevent frost, which can melt and short out your motherboard. The hot and cold elements are all microprocessor-controlled, with fail-safe logic that powers off your PC if the Mach II has a meltdown.

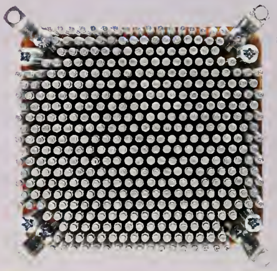
[**nVentiv Mach II**: $820, *www.nventiv.com*]

HEAT BEATER

Let your blazing motherboard rest on the hefty, 2.5-pound MCX4000-T from Swiftech. It brings processors below room temperature with a built-in 226-watt thermoelectric cooler. Voltage passes through the MCX's copper core element, making one plate very hot and one plate very cold. The cold side kisses your CPU with a mirror-smooth surface for maximum thermal transfer, and the hot side is cooled down with 429 ribbed pins. You can play until hell freezes over.

[**MCX4000-T**: $95, *www.swiftnets.com*]

[front]



[back]

Celebrity Stuff

> "I am so gadget! I love gadgets! Me, Dom [Monaghan], and Elijah [Wood] would play PlayStation 2 a lot when we were making *Lord of the Rings*. We're setting it up to play over broadband now that we're away from each other."

BILLY BOYD

Actor, *Lord of the Rings, Master and Commander*

His Favorite Gear

[01] Sony PlayStation 2
[02] Canon PowerShot S230 ELPH digicam
[03] Apple 15-Gbyte iPod

His Wish List

"This new robot vacuum thing [Electrolux] sounds like the best gadget ever! Just switch it on and it cleans out your room, it can 'see' where your chairs are. And if it runs out of power, it just returns to its docking station and recharges. It's a vacuum cleaner, but it could also be a friend, I think. Like having a dog."

SONY

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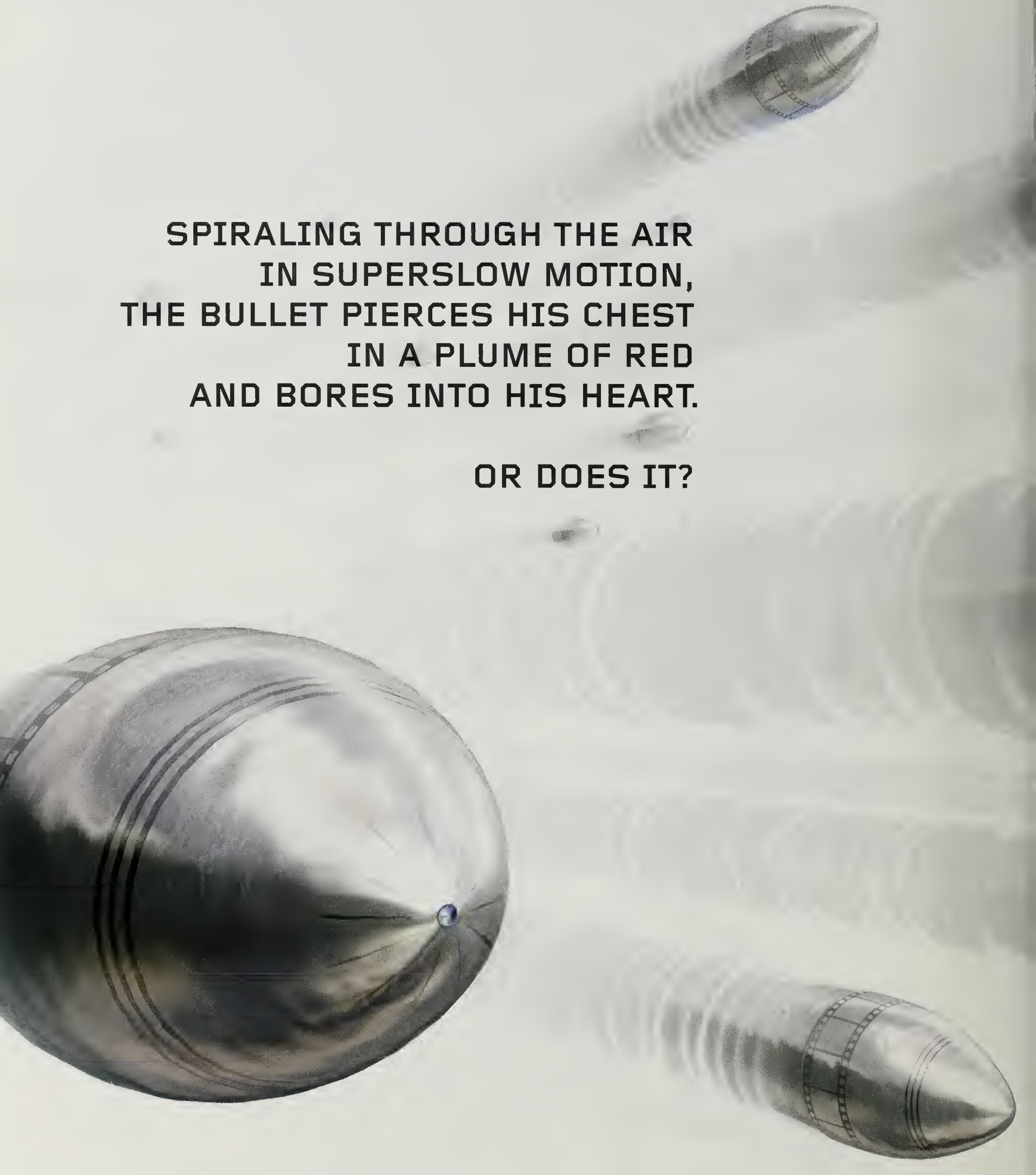


SPIRALING THROUGH THE AIR IN SUPERSLOW MOTION, THE BULLET PIERCES HIS CHEST IN A PLUME OF RED AND BORES INTO HIS HEART.

OR DOES IT?

WIRED december 2003

illustration by Kenn Brown

THE SECOND COMING OF

PHILIP K. DICK

The inside-out story of how a hyper-paranoid, pulp-fiction hack conquered the movie world 20 years after his death.

by Frank Rose

BACKGROUND: N[illegible] STILLS FROM TOP: MPTV, MPTV, EVERETT [illegible]

The unbilled costar of *Paycheck*, the latest Hollywood thriller from the battered typewriter of Philip K. Dick, is a bullet.

A crack engineer named Jennings, played by Ben Affleck, finds himself in a jam, as Dick's characters invariably do, and the bullet is headed his way. Spiraling through the air in superslow motion, it pierces his chest in a plume of red and bores into his heart. Or does it? Though the image recurs throughout the film, it's hard to tell whether it's actually happening or not. Philip K. Dick liked nothing better than to toy with the fundamentals of human existence, reality chief among them, so what better for the movie than a bullet that may or may not be tearing through the main character's flesh? Like other Dick protagonists – Tom Cruise in *Minority Report*, Arnold Schwarzenegger in *Total Recall*, Harrison Ford in *Blade Runner* – Affleck finds himself struggling for equilibrium in a world where even the most elemental questions are almost impossible to answer. Can the senses be trusted? Are memories real? Is *anything* real?

Paycheck, directed by John Woo and set to open Christmas Day, is the latest in a run of films based on Philip K. Dick stories that began 21 years ago with *Blade Runner*. The writer's hallucinatory tales make for suspense with an epistemological twist: full-bore action pics that turn on questions of perception versus reality. Having agreed to have his memory erased after completing a super-sensitive job, Jennings learns that he apparently signed away his $4.4 billion paycheck in exchange for an envelope of trinkets. Armed men are chasing him, but he has no idea why until he teams up with Rachel (Uma Thurman), whom he vaguely recalls meeting just before he started the job. Jennings, it turns out, is a man who has seen the future but can't remember it.

Dick died shortly before *Blade Runner*'s release in 1982, and, despite a cult readership, he spent most of his life in poverty. Yet now, more than two decades later, the future he saw has made him one of the most sought-after writers in Hollywood. *Paycheck*, based on a 1953 short story Dick sold to a pulp magazine for less than $200, will bring close to $2 million to his estate. And movies based on more than a half-dozen other stories and novels are in the works – among them "The King of the Elves" at Disney, "The Short, Happy Life of the Brown Oxford" at Miramax, and *A Scanner Darkly* at Warner Bros.

Dick's anxious surrealism all but defines contemporary Hollywood science fiction and spills over into other kinds of movies as well. His influence is pervasive in *The Matrix* and its sequels, which present the world we know as nothing more than an information grid; Dick articulated the concept in a 1977 speech in which he posited the existence of multiple realities overlapping the "matrix world" that most of us experience. *Vanilla Sky*, with its dizzying shifts between fantasy and fact, likewise ventures into a Dickian warp zone, as does

PORTRAIT: ART STREIBER; GROOMER: APRIL HUTCHINSON; STYLIST: SUZIE HARDY; JACKET: HUGO BOSS@BLOOMINGDALES; STILLS: PARAMOUNT

Paycheck director John Woo, above and inset with stars Uma Thurman and Ben Affleck, made his name with violent ballets of bullets; his new inspiration: Hitchcock.

Dark City, *The Thirteenth Floor*, and David Cronenberg's *eXistenZ*. *Memento* reprises Dick's memory obsession by focusing on a man whose attempts to avenge his wife's murder are complicated by his inability to remember anything. In *The Truman Show*, Jim Carrey discovers the life he's living is an illusion, an idea Dick developed in his 1959 novel *Time Out of Joint*. Next year, Carrey and Kate Winslet will play a couple who have their memories of each other erased in *Eternal Sunshine of the Spotless Mind*. Memory, paranoia, alternate realities: Dick's themes are everywhere.

At a time when most 20th-century science fiction writers seem hopelessly dated, Dick gives us a vision of the future that captures the feel of our time. He didn't really care about robots or space travel, though they sometimes turn up in his stories. He wrote about ordinary Joes caught in a web of corporate domination and ubiquitous electronic media, of memory implants and mood dispensers and counterfeit worlds. This strikes a nerve. "People cannot put their finger anymore on what is real and what is not real," observes Paul Verhoeven, the one-time Dutch mathematician who directed *Total Recall*. "What we find in Dick is an absence of truth and an ambiguous interpretation of reality. Dreams that turn out to be reality, reality that turns out to be a dream. This can only sell when people recognize it, and they can only recognize it when they see it in their own lives."

Like the babbling psychics who predict future crimes in *Minority Report*, Dick was a precog. Lurking within his amphetamine-fueled fictions are truths that have only to be found and decoded. In a 1978 essay he wrote: "We live in a society in which spurious realities are manufactured by the media, by governments, by big corporations, by religious groups, political groups. I ask, in my writing, What is real? Because unceasingly we are bombarded with pseudorealities manufactured by very sophisticated people using very sophisticated electronic mechanisms. I do not distrust their motives. I distrust their power. It is an astonishing power: that of creating whole universes, universes of the mind. I ought to know. I do the same thing."

Viewed in this context, Dick's emergence in Hollywood seems oddly inevitable. His career itself is a tale of alternate realities. In the flesh he was the ultimate outsider, pecking out paranoid visions that place the little guy at the mercy of the corporate machine. Yet posthumously he feeds the machine, his pseudoworlds the basis of ever more elaborate entertainments doled out by the megacorporations we pay to stuff our heads. How he made the leap from pulp-fiction writer to Hollywood prophet is a tale almost worthy of the man himself.

Like a precog, he saw a future bombarded with manufactured realities. Our future.

Dick's career in movies did not begin with a bang. It was 1977, and a small-time actor named Brian Kelly wanted to option the 9-year-old novel *Do Androids Dream of Electric Sheep?* For a mere $2,500, he got it. "The works of Philip K. Dick were not exactly in demand," recalls the writer's New York literary agent, Russell Galen, "and for Phil" – then 49 and living in suburban Orange County – "that was enough to make the difference between a good year and a bad year." Kelly's partner wrote a screenplay and shopped it around. Eventually it landed on the desk of Ridley Scott, who'd just directed *Alien*. Scott brought in a new writer and sent it to Alan Ladd Jr., one of the top players in Hollywood.

"I liked the project," says Ladd, a quiet, deliberate man whose Beverly Hills offices are lined with posters for the films he's made: *Star Wars*, *The Right Stuff*, *Chariots of Fire*, *Braveheart* ... "It was a good old-fashioned detective story set in the future." Ladd thought Harrison Ford, who'd costarred in *Star Wars*, would be good as a Humphrey Bogart-type sleuth. *Blade Runner* was a go.

Just a few months before the movie's release, Dick suffered a massive stroke. *Blade Runner* proved only a modest success at the box office; if not for two other developments, Dick's career might have died with him. The first was the emergence of home video, which gave new life to small films with cult followings. Throughout the '80s, *Blade Runner*'s reputation as a noirishly futuristic gem continued to build. The second was the interest of Ron Shusett, a screenwriter who'd worked on *Alien*. Before Dick died, Shusett bought the film rights to "We Can Remember It for You Wholesale," a story about a nebbishy clerk with dreams of going to Mars. He retitled it *Total Recall* and took it to Dino De Laurentiis, who put it into development.

Total Recall languished for years before all the elements – producer, director, star – came together. At one point, Richard Dreyfuss was attached. At another, David Cronenberg was going to direct and wanted William Hurt for the lead. "I worked on it for a year and did about 12 drafts," Cronenberg recalls. "Eventually we got to a point where Ron Shusett said, 'You know what you've done? You've done the Philip K. Dick version.' I said, 'Isn't that what we're supposed to be doing?' He said, 'No, no, we want to do *Raiders of the Lost Ark Go to Mars*.'" Cronenberg moved on. Arnold Schwarzenegger wanted to star, but De Laurentiis refused: Even in an overamped Hollywood bastardization, he couldn't see Schwarzenegger in the part. Instead, it went to Patrick Swayze, with Bruce Beresford directing. They were building sets in Australia when De Laurentiis' company went bankrupt.

This gave Schwarzenegger his chance. He got Carolco, the high-flying mini-studio behind the *Rambo* series, to buy the property, and Paul Verhoeven to direct it. The henpecked clerk named Quail became a muscle-bound construction worker named Quaid, and a new ending was written to make up for what many filmmakers see as the problem with Dick's short stories: their lack of a third act that will take a movie to 90 minutes or more. But while Verhoeven's film was an interplanetary shoot-'em-up that bore little resemblance to Dick's story, it did retain the tale's essential ambiguity: At the end, we're not sure whether the main character actually went to Mars or only thought he did, thanks to some memory implants he bought. "This was extremely innovative, coming from a Hollywood studio,"

Contributing editor Frank Rose (rose@wiredmag.com) *wrote about the future of television in* Wired *11.10.*

REALITY CHECK

Uma Thurman on the surreal world of Dick, karmic paybacks, and working with mind-bending auteurs.

"It's all very Buddhist," says Uma Thurman, sitting in a dressing room as a makeup artist dabs at her face.

She means Philip K. Dick, of course. Her father, Columbia University professor Robert Thurman, is a leading Buddhist scholar and a good friend of the Dalai Lama, so she's no stranger to discussions of memory and reality. "Reality is an illusion – that's the principle of ancient Buddhist thought," she continues. "And the basic idea of being reborn is that you erase the memory. Everybody is interconnected, and you're working out your karma with people – so you get erased, but all work left undone has to be completed."

So Thurman is a fan. *Blade Runner* was one of her favorite movies growing up – the plight of the replicants was so affecting it made her cry – and after seeing it she read Dick's novel. "There's something very earthly in his imaginings," she says. "You don't have to set them on Mars – they're projections from here on Earth. There's class struggle, there's government deceit. And these nightmarish fantasies about corporations owning the world – I mean, obviously there's a reason people relate to that."

Thurman was coming off a grueling 11-month shoot in China for Quentin Tarantino's *Kill Bill* when she received the offer to costar in *Paycheck*. "I never get asked to be 'the girl,'" she says, "so I was sort of thrilled to just be the sidekick in a romantic context, instead of the man/woman/fighter/stunt-double/you-name-it. I thought that would be nice – to not be the one covered in blood." She also wanted the chance to work with John Woo, whose Hong Kong films Tarantino had reverentially screened for her.

"I was completely blown away," she says. "I've always been drawn to directors who have a real voice." She was 17 when Terry Gilliam cast her in *The Adventures of Baron Munchausen*. After that came, among others, Stephen Frears' *Dangerous Liaisons*, Gus Van Sant's *Even Cowgirls Get the Blues*, Tarantino's *Pulp Fiction*, Andrew Niccol's *Gattaca*, and James Ivory's *The Golden Bowl*. "It's special, being in front of those cameras. It doesn't mean the movie's going to work, but I'd rather err with that kind of director. They've each created their own world, many times over." – **F.R.**

FRANK OCKENFELS; STYLIST: JILL SWID; HAIR: OSCAR BLANDI; MAKEUP: MARIE JOSE

says Verhoeven. "To dare to say, Everything you see could be a dream, or everything you see could be reality, and we won't tell you which is true – I thought that was pretty sensational."

Total Recall was one of the biggest hits of 1990, grossing $118 million in the US alone. That was good for Carolco, even better for Dick. "The whole phenomenon of Philip K. Dick short stories selling for a lot of money started with *Total Recall*," says Russell Galen, the literary agent, who now represents his estate. Before *Total Recall*, Dick was a Hollywood unknown; afterward, screenwriters and producers saw his stories as properties they could build action movies around. And there were dozens of these properties – 36 novels and more than 150 short stories, most as-yet unoptioned.

It would be a while before anything was available. Dick had died without a will, and his estate was in probate for 11 years. When it was finally settled, however, Galen had work to do. Warner Bros. bought the novel *Time Out of Joint* for Joel Silver (who went on to produce the *Matrix* series) and optioned *A Scanner Darkly* for George Clooney and Steven Soderbergh's production company, Section 8. The Jim Henson Company optioned "The King of the Elves" and set it up as a children's film at Disney. Spyglass Entertainment, makers of M. Night Shyamalan's *The Sixth Sense*, took an option on "Paycheck." Business got so heavy that Galen had to devise a computerized chart showing what's available, what's been optioned and will become available in the future, and what's been sold outright.

Amphetamines and five marriages teach you how fast your world can fall apart.

One of the first to go was "The Minority Report," a short story published in the January '56 issue of *Fantastic Universe*, about a police commander who uses clairvoyants to arrest people before they actually commit a crime. Gary Goldman, the screenwriter who'd reworked *Total Recall* for Verhoeven, brought it to the director, who decided it would make a great sequel. This was a story in which Dick's obsession with alternate realities dovetailed with a fascination with fate: If we can see into the future, does that mean the future is set? That humans have no capacity for free will? Verhoeven envisioned *Total Recall II: The Minority Report* as a whiz-bang, action-packed, "theological-philosophical challenge" to the Calvinist concept of predestination. But Carolco went bankrupt before he could make it. So Goldman took it to director Jan de Bont, Verhoeven's former cinematographer, who showed it to Tom Cruise, who'd been thinking for some time about doing a science fiction picture with Steven Spielberg.

To Galen, the 1998 announcement that Cruise and Spielberg would team up to make *Minority Report* was electrifying. Three years passed before they actually got to it, and when they did the movie departed significantly from the short story, which was a paranoia-soaked potboiler in which the police commander in charge of "pre-crime" is framed by his new deputy, or his wife, or an ex-general, or all or none of the above. "I don't think Phil was all that interested in the morality of pre-crime," says Goldman, an executive producer of the film. But Spielberg was, and the movie ends with a ringing endorsement of the American justice system. "It's very difficult to be true to Phil Dick and make a Hollywood movie," Goldman observes. "His thinking was subversive. He questioned everything Hollywood wanted to affirm." No matter. With the release of *Minority Report*, Dick became an A-list Hollywood scribe, a player, a member of the club.

Vancouver, June 2003. The *Paycheck* shoot is well under way, and this morning Woo is rehearsing one of the opening scenes. A vast soundstage on the edge of town has been converted into the headquarters of Allcom, a company that seems to be an unholy marriage of Microsoft, Monsanto, and GE. On one side of the soundstage is the bio lab, a rainforest of orchids and bromeliads and water lilies and trees reaching up to the ceiling, interspersed with catwalks and robot arms. This is Uma's domain. On the other side, behind an enormous door, is the computer lab Ben is about to disappear into. When he emerges, three years later, it will be with his memory wiped. But on his way in, he captures Uma's attention. Mischievously, she hits him with a blast of air almost strong enough to bowl him over. "I give up! I give up!" he cries, slicking back his hair. In a flash a robot arm swings in front of him, halting an inch or two from his face. In its pincers, a yellow orchid.

"Don't give up," Uma says softly.

There are plenty of action sequences in *Paycheck* – a motorcycle chase through the streets of Vancouver, a climactic fight scene replete with explosions, gunfire, and people diving through the air. But for Woo, that's not the point. Woo made his name in Hong Kong in the '80s with hyperviolent cult films like *A Better Tomorrow* and *The Killer* – maximum spatter rendered with balletic grace. Transplanted to Hollywood in the '90s, he graduated to big-budget action-adventure tales, most notably *Face/Off* and *Mission: Impossible 2*, the second-highest-grossing film of 2000. But like other genre directors, he dreams of greater things. "*Paycheck* is a suspenseful movie, but also it is a love story," he says in heavily accented English while the crew preps the next shot. "Usually, science fiction movies are pretty cold. I am trying to make this one more human. Some of the scenes are a tribute to" – he claps a hand over his mouth, pretending he's afraid to utter the word – "Hitchcock."

Woo cites Hitchcock – along with '30s musicals, Francis Ford Coppola, and the blood-soaked Westerns of Sam Peckinpah – as a major influence. "Hitchcock's movies are so precise," he says admiringly. "Every shot is calculated. And they're not only about suspense – I also find them very romantic." He mentions the scene in *The Birds* when Tippi Hedren is driving to meet Rod Taylor, a pair of lovebirds in a cage on the floor: There are lovebirds in *Paycheck*, too. He mentions the scene in *North by Northwest* when Cary Grant is chased by a crop duster in an Indiana cornfield: In *Paycheck*, Affleck is chased by a train. "Ben plays an ordinary man, not a superhero," Woo says. "Just like a young Cary Grant – that's how I want him to be."

"This is a part I went after really aggressively," says Affleck. "I've always been a fan of Philip K. Dick, both his writings and the movie adaptations. They're big-budget movies for smart people." Too often, Affleck admits, that's an oxymoron: "There's a tendency to dumb these movies down – they're spending so much money on them, and conventional wisdom dictates that you have to go for the lowest common denominator. But his ideas prevent that. To anybody who's ever thought, Did that happen or did I dream it? – you'd have to have a PhD in philosophy to get too deep into this, but it has to do with wanting to validate our own first-person experience."

Just as Spielberg was dismissed by hardcore Dick fans, Woo strikes many as unworthy. They probably don't realize that the *Matrix* series contains almost as many references to Woo as to Dick. (Fluttering pigeons heralding a fight, a shooter with two guns blazing – pure Woo.) And though he makes exceptions for *Star Wars* and Spielberg's *Close Encounters of the Third Kind*, Woo thinks most science fiction is limited in scope.

But then, so did Dick. In response to a 1969 questionnaire, Dick described SF's greatest weakness as "its inability to explore the subtle, intricate relationships that exist between the sexes," adding that as a result it "remains pre-adult, and therefore appeals – more or less – to pre-adults." The male-female relationships in Dick's work tend to be more dysfunctional than romantic, but the idea of Woo interpreting Dick through Hitchcock makes sense: These are three genre artists who've transcended their category. Certainly if Hitch had tackled science fiction, his trademark combination of paranoia and suspense would have fit Dick perfectly.

Philip K. Dick appeals to Woo, and to studio execs as well, because the humans take precedence over the science fiction elements of his stories – the robots, the gizmos, the spaceships that transport you to Mars. The ideas are a bonus, though in "Paycheck" and other early pulp-fiction stories, they're not always well developed. "One thing he didn't go into," observes Dean Georgaris, who wrote the *Paycheck* screenplay, "is what kind of person would agree to have a large portion of his memory erased. For me, that was the key that opened the door to the movie. It's about what's important in life – is it the great moments, or the little things that add up?" But the big question Dick only hinted at was what people would do if they had the machine Jennings built before his mind was wiped – a machine whose nature only gradually becomes apparent in the movie. "Would we become addicted to it, like we've become addicted to TV?" Georgaris wonders. Movies like *The Terminator* and *The Matrix* are about machines that attack humans. The more likely scenario, Georgaris thinks, is that humans will submit voluntarily.

It may be for the best that Dick's career in Hollywood took off only after his death, because he'd certainly have had a hard time handling it in life. Psychologically, the guy was a mess. His fear of going out in public was so bad it's difficult to imagine him taking a meeting at a film studio. According to Isa Dick-Hackett, one of three children he produced in five marriages, he couldn't even make good on a promise to take her to Disneyland when she was little. "Twenty or thirty minutes into it, he started to complain of back pain and had to leave," she says. "Later, I realized the crowds just freaked him out."

The Philip K. Dick estate has no such problems. Isa and her older half-sister, Laura Leslie, are upstanding Bay Area citizens, both intelligent and obviously competent. Together with their younger half-brother, Chris, who works as a martial arts instructor in Southern California, they control their father's legacy. Russell Galen advises them from New York. The four take their stewardship seriously:

THE METAPHYSICS OF PHILIP K. DICK

Don't know Dick? Here's his philosophy in capsule form. (Warning: May cause anxiety or dizzyness.)

1. FALSE REALITIES

Today we are almost bored by the idea that reality is a just a construct – neuroscience, postmodernism, and *The Matrix* have made sure of that. But Dick remains the supreme mythmaker of the false reality. His 1959 novel, *Time Out of Joint*, was the original *Truman Show*, while his 1964 book, *The Three Stigmata of Palmer Eldritch*, describes a society that succumbs to permanent hallucination. Faced with such illusions, Dick's characters have to ask, "What is real?" because their lives (and sanity) are on the line. That's why hipster Hollywood loves him: Dick turned metaphysics into a whodunit.

2. HUMAN VS. MACHINE

Dick wanted to know how, in a technological society, we can recognize the authentically human. He saw the line between people and machines become hopelessly blurred. So his human characters often behave like cruel robots, while spunky gadgets – like the automatic cabbie in *Now Wait for Last Year* – can be sources of wisdom and kindness. And in "The Electric Ant," when businessman Garson Poole discovers that he is actually an android, he doesn't despair. Instead, he begins to reprogram himself.

3. ENTROPY

One thing you learn from drug addiction, five marriages, and a visionary imagination is how easily your world can fall apart. Perhaps this was why Dick was obsessed with how things decay. He even invented a word for one of entropy's most ordinary manifestations: "kipple," which he defined as all the useless crap that creeps into our daily lives, like junk mail and gum wrappers and old newspapers. Don't bother fighting it – Dick's First Law of Kipple states that "Kipple drives out nonkipple."

4. THE NATURE OF GOD

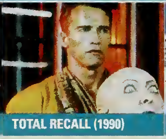
Dick was a garage philosopher, an autodidact who read voraciously in religion and metaphysics. Sometimes his speculations leaked into everyday life. In 1974, undergoing a psychotic and/or mystical break, Dick encountered a cosmic force he later called Valis, which stands for Vast Active Living Intelligence System – a cybernetic God. But keep on your toes: To sneak into our fallen world, Valis must disguise itself as TV ads or trash – or pulpy sci-fi entertainment.

5. SOCIAL CONTROL

Dick was always pretty paranoid. But when thieves broke into his home in 1971, it sent him over the edge. Soon he came to believe that all political tyrannies were facets of one cosmic oppressor: the Black Iron Prison, a timeless archetype that he associated with the Roman Empire. Dick sometimes thought that history was an illusion and that the Nixon administration's dirty tricks only proved that "The Empire never ended." One wonders what he would think today. – **Erik Davis**

THE HOLLYWOOD TREATMENT

Why do filmmakers love Philip K. Dick? Credit his mix of head-spinning imagination and high-concept action – not to mention big fans like Tom Cruise. Of course, Dick's paycheck was a bit smaller. Here's a breakdown of PKD movies so far:

	 BLADE RUNNER (1982)	 **TOTAL RECALL (1990)**	 **SCREAMERS (1996)**	 **IMPOSTOR (2002)**	 **MINORITY REPORT (2002)**	 **PAYCHECK (2003)**
PLOT	A bounty hunter chases down and kills remarkably human androids, then begins to suspect he might be one himself.	A man tries to take a virtual vacation on Mars, only to learn he's actually a secret agent fighting a brutal dictatorship there.	An army commander on a distant planet battles androids that can be distinguished from humans only by their screams.	A scientist who has developed killer androids is arrested and charged with being one.	A police officer in a unit that captures murderers before they strike is then accused of a future crime himself.	An engineer whose memory is erased races to find out why he traded a huge payday for seemingly useless trinkets.
DIRECTOR	Ridley Scott	Paul Verhoeven	Christian Duguay	Gary Fleder	Steven Spielberg	John Woo
STAR	Harrison Ford	Arnold Schwarzenegger	Peter Weller	Gary Sinise	Tom Cruise	Ben Affleck
GROSS (US)	$28 million	$119 million	$6 million	$6 million	$132 million	opens December 25
BASED ON	*Do Androids Dream of Electric Sheep?* (1968)	"We Can Remember It for You Wholesale" (1966)	"Second Variety" (1953)	"Impostor" (1953)	"The Minority Report" (1956)	"Paycheck" (1953)
WHAT DICK GOT PAID	$1,250	NA	$375	$75	$130	$195

CLOCKWISE: EVERETT; PARAMOUNT, EVERETT, EVERETT, EVERETT, EVERETT, MPTV, EVERETT

They're fine with repackaging a novel to tie in with a movie, for example, but novelizations of short stories are out. And thanks to Vintage Books, every word of his fiction will soon be in print – as you'd expect for an author who's now taught in colleges and cited by the French post-structuralist philosopher Jean Baudrillard.

As for film deals, the estate has become increasingly choosy. "We sort of feel like we have to protect Philip K. Dick's brand image," says Galen. "So we set very, very high prices, and we'll only do business with people who are established. It's ironic, because the films that created the phenomenon started with options that were granted to struggling filmmakers. Today, we shun people like that." Not every movie based on Dick's writings has been a hit: The 1996 film *Screamers*, starring Peter Weller, and last year's *Impostor*, with Gary Sinise in the lead, grossed only $12 million between them. "But in Hollywood, what matters is getting the movie made," explains Galen. "If somebody options a story and it's not made, that spoils the track record."

Still, most Hollywood writers, even successful ones, live mainly off properties that are sold but not developed, and the Dick estate is no exception. Of the more than half-dozen film projects currently in the works, some are inching forward while others are caught in limbo. John Alan Simon, who produced *The Getaway* with Alec Baldwin and Kim Basinger, and his partner, Dale Rosenbloom, are trying to get studio backing for films based on three Dick novels – *Radio Free Albemuth*, *Valis*, and *Flow My Tears, the Policeman Said*. Miramax has a script and is looking for a director for "The Short Happy Life of the Brown Oxford," a story about a shoe that comes alive. ("With the right actor and the right filmmaker, it will be memorable," says development exec Michael Zoumas. "Without them it will be, what were they thinking?") Both Joel Silver's *Time Out of Joint* and Steven Soderbergh's *A Scanner Darkly* are idling while the producers work on other projects. As Galen puts it, "To have *Minority Report* and *Paycheck* back-to-back like that" – big-budget films with big-name stars and a top director – "requires an incredible planetary alignment."

Science fiction was a ghetto in the '50s: Dick was prolific because he needed cash.

Dick's kids grew up poor – no health insurance, clothes from Goodwill. Laura recalls how grateful she was to get braces. But the hard-scrabble life was critical to Dick's sensibility. "Phil's work came out of an atmosphere of want and struggle," Galen observes. Science fiction was a ghetto in the '50s and '60s, and Dick was one of its least fashionable residents: While Isaac Asimov and Arthur C. Clarke were writing best sellers, he counted himself lucky not to be collecting rejection slips. "From the day he wrote his first story, he was worried would he ever get another sale," Galen says. "Certainly he was as prolific as he was because he needed money. We have 30-odd Philip K. Dick novels and not 10 because he was not that well paid."

How celebrity would have affected him is a different question. "He would never have been that Hollywood thing, ever," says Laura, sitting with Isa on the patio of Spago in Palo Alto. The closest he came was buying a sports car, shortly before he died. But he was afraid to drive it, and apparently with good reason: "6,000 miles, and it had dents all over it," Laura observes. In most ways, they agree, he wouldn't have changed. He wouldn't have gotten health insurance. Instead of filing his income taxes, he'd have continued to claim he was handing everything over to "Mrs. Frye" at the IRS. (As far as the daughters know, Mrs. Frye never existed.) This is a guy who had to have a friend take Isa to the toy store because he couldn't handle the anxiety. "The thought of the general public knowing who he was," she says now – "he would have been out of his mind."

As things turned out, he never had to worry about it. Instead, it's Laura and Isa who deal with his fame. The two daughters had quite different upbringings, and as primary guardians of the estate they play equally divergent roles. Laura, trim and proper and blond, saw her father only four times after the age of 3, but she read all his books when she was 12, and the two corresponded and talked on the phone constantly. Today she shuns publicity and focuses on the deals. Isa was brought up in a fundamentalist Christian home; every book her father sent was burned because it contained swear words. Outgoing and enthusiastic, with dark curls cascading almost to her shoulders, she likes to reach out to the fans. Now, for example, she's working with Jason Koornick, who runs the fan site PhilipKDick.com, to convert it into an official one – a place where they can post unpublished letters and other documents.

Neither of the daughters was prepared for the Spielberg effect. "The whole *Minority Report* thing blew us away," says Laura. "It was so unexpected" – the hubbub of the New York premiere, the glamorous party at Cipriani, the effusive praise from stars like Tom Cruise and Colin Farrell. "We didn't realize what a phenomenon our dad was."

"He's a question on *Jeopardy*," Isa interjects.

Laura recalls a Dean Koontz story that contains a remark about "having a Philip K. Dick moment." She finds the notion a little unsettling: Her world was full of Philip K. Dick moments. "That was just my dad," she says. "The concept of alternate realities – I thought that was the way everybody talked."

In his 1974 novel *Flow My Tears, the Policeman Said,* Dick wrote about the sudden shift experienced by Jason Taverner, a world-famous talk-show host who wakes up one morning to find that no one has heard of him and no record of his identity exists. Dick's own experience of celebrity is almost the reverse: For decades, no one outside the science fiction ghetto had heard of him, and now he's world-famous, the kind of guy Tom Cruise and Steven Spielberg talk about on *Oprah*. All this fame came at the stage in life when he was best able to handle it – after he was dead. "I feel so happy for him," Isa declares. "He was so afraid of death – and how amazing for him."

"He's going to live forever," says Laura, continuing Isa's thought. "Every day, more and more people know him."

"He transcended death," Laura says, a note of wonder in her voice – half awe, half bemusement. As if to say: How very Philip K. Dick. ■ ■ ■

“Hope Is a Lousy Defense.”

Sun refugee Bill Joy talks about greedy markets, reckless science, and runaway technology. On the plus side, there’s still some good software out there.

by Spencer Reiss photographs by Susanna Howe

There are geeks and then there's **Bill Joy** – 49-year-old software god, hero programmer, cofounder of Sun Microsystems and, until he quit in September, its chief scientist. Beginning in 1976, he spent zillions of hours in front of a keyboard, coding the now-ubiquitous Berkeley strain of the Unix operating system; then he godfathered Sun's Java programming language and helped design servers that were the Internet's heaviest artillery. In the early 1990s, he kept his job but bolted Silicon Valley, "leaving the urgent behind to get to the important," he says. In 2000, he wrote the *Wired* cover story "Why the Future Doesn't Need Us," a Cassandra cry about the perils of 21st-century technology and a striking display of ambivalence from a premier technologist. Now, at home 8,000 feet up in Aspen, Colorado, Joy talks about building a technological utopia while worrying about a techno-apocalypse.

WIRED: We're tempted to say, "End of an era."
JOY: I don't see it that way. I try to work on things that won't happen unless I do them. Not all those things are strongly advantaged by my being at Sun.

Still, 21 years at Sun. Did you get a gold watch?
They gave me a clear plastic globe or something.

And now Scott McNealy is the last founder left, right?
We're all still alive.

"LINUX IS GREAT FOR KIDS. I MUCH PREFER MAC OS X."

I mean, left at the company.
We're still there in spirit. There are an awful lot of good people at Sun who have been there a long time. Sometimes, founders leaving is a good thing. You start to get in the way.

No doubt, but you were pretty loosely tethered at the best of times.
I've always said that all successful systems were small systems initially. Great, world-changing things – Java, for instance – always start small. The ideal project is one where people don't have meetings, they have lunch. The size of the team should be the size of the lunch table.

You're doing a startup?
Did I say that? Well, maybe.

But innovation is supposed to be dead.
Nonsense. Moore's law still has at least a decade to go with conventional silicon. That's a factor of 100 in performance, which means that with some work to make the algorithms run faster, we've got maybe a factor of a thousand improvement still to come. If you give me machines that are a thousand times as powerful as today's at the same price, I ought to be able to do something radically better. Thirty years ago a supercomputer was 80 megahertz. Now a personal computer is 2 gigahertz, and yet the software isn't 25 times better. I just got a new Mac with two 2-gigahertz processors, 8 gigabytes of memory, and a half a terabyte of internal disk.

Good for Apple. So what?
So you have the ability to hold a huge simulation all in memory – a database becomes a data structure. Add 64-bit computing and I can do breathtaking visualization. But that's not a space I'm going to go into, by the way. People's expectations in three dimensions are so high. On the other hand, existing operating systems, especially the ones provided by the reigning monopolist here, are deeply flawed. So there's enormous opportunity.

Is that something that you'd want to take on?
Jini networking technology was a partial attempt. Rather than writing distributed applications, you write a program – the whole system is an application program. But Jini was a solution to a problem that people didn't know they had.

Which was?
Reliable and secure systems. We all know that now – 4,000 known Microsoft viruses later, *The Wall Street Journal* says.

And yet you've been famously cool about Linux.
Re-implementing what I designed in 1979 is not interesting to me personally. For kids who are 20 years younger than me, Linux is a great way to cut your teeth. It's a cultural phenomenon and a business phenomenon. Mac OS X is a rock-solid system that's beautifully designed. I much prefer it to Linux.

What about the open source idea in general?
Open source is fine, but it doesn't take a worldwide community to create a great operating system. Look at Ken Thompson creating Unix, Stephen Wolfram writing Mathematica in a summer, James Gosling in his office making Java. Now, there's nothing wrong with letting other people help, but open source doesn't assist the initial creative act. What we need now are great things. I don't need to see the source code. I just want a system that works.

And that beats Windows.
My goal is to do great things. If I do something great, maybe it'll beat Microsoft. But that's not my goal. I find Windows of absolutely no technical interest. They took systems designed for isolated desktop systems and put them on the Net without thinking about evildoers, as our president would say.

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Still, a lot of people have lost a lot of money over the years shorting Microsoft.
We're just lucky that no one has sent around a virus that erases people's disk drives. I sure hope that doesn't happen, but it's not exactly hard to imagine someone doing it. And hope is a lousy defense.

At last, a warning about impending technological disaster. Are you more or less worried than when you wrote "Why the Future Doesn't Need Us"?
My biggest worry then was that people weren't paying attention. Obviously 9/11 changed that, but I'm not sure we've learned the right lessons. We can't go out and rid the world of evil, as our president seems to think. These technologies won't stop themselves, so we need to do whatever we can to give the good guys a head start. And we still don't get it about epidemics. Even SARS was just a TV story about a bunch of people wearing masks.

"DISCUSSION WON'T START WITHOUT A BIG ACCIDENT. IF ANY OF US ARE STILL AROUND."

But the future really *does* need us, right? Someone has to write the software.
Well, that was *Wired*'s title, not mine. But I stand by everything I wrote. I just wish people reading it on the Web could tell more easily when it's me speaking and when I'm quoting someone else – the Unabomber, for instance. Such is the fate of the engineer: hoist by my own device.

You've talked about that story as "public penance." For what?
Success. I benefited a lot from earlier generations' sacrifice in setting up the system so I could be as creative as I wanted to. It was a part of me giving back.

Did the criticisms of it affect you?
Not really. Very few of them were well-considered. It seems that people don't really want to spend much time thinking about this stuff. The most interesting criticisms focused on what needs to be done.

Which you didn't write about.
If I had proposed a set of solutions, it wouldn't have been as striking. Shortly after the article came out I did publish a short list of suggestions as an op-ed in the *Washington Post*. I wish it had received more attention.

You did once say that we shouldn't "let the future just happen." Haven't laissez-faire and free markets won out over planned economies?
Our problem is no longer "going faster," getting to the future as fast as possible, but rather dealing with limits – limiting our own greed to avoid disaster in the environment and limiting what rogue individuals and states can do. Market mechanisms don't address these problems. Things that aren't accounted for in the cost equations – especially catastrophic events, the value of our survival – don't get dealt with.

Are you any more at peace with what you see coming?
Not when the forces at play are so powerful that we have such strongly negative possible outcomes. Do we care whether we get a police state without civil liberties because the government's "protecting us" from terrorists? I think we do care. Are people paying enough attention to stop it? I don't think so.

There must be something to be cheerful about.
How about, there's so much good software that can be written for the machines that we have now, let alone those that are a hundred times faster. When Moore's law ceases to be true, maybe around 2014 – that would be a good time to retire.

Whatever happened to the book you were writing to follow up the article?
I've written two manuscripts. The first was a wake-up call – that's obviously not the book we need anymore. The second was prescriptive, and the problem is, I'm not satisfied with the prescriptions that I have. You don't get two shots at something like this, so I'm holding off.

Meanwhile the markets continue to pour money into the fields that worry you – genomics, nanotechnology, and robotics.
Because they don't have to pay the bill.

You mean the damages if something goes wrong?
Right. But I'm afraid we're not going to have this discussion until there's a really big accident, and maybe not even then. Assuming any of us are still around to have the discussion.

A cynic would say that your *Wired* story made noise but the result was you in an Audi ad with "Jini" and "Java" painted on your face.
As long as the Bush administration is in power, nothing's going to get done about any of this. The liability is going to get transferred to the next generation, like everything else.

But you've said aspects of the war on terrorism infringe on civil liberties. Aren't you calling for something similar with respect to technology?
I'm not saying the government should do it. Centralized strategies – things like Admiral Poindexter's Total Information Awareness program – don't work. What I'm saying is "physician, heal thyself." People in the various scientific communities have to police themselves.

Like the Russell-Einstein Manifesto from 1955 – where we get the phrase "weapons of mass destruction."
I certainly think a Hippocratic Oath for scientists would be useful. And I think an essential part of getting control of technology will be for international organizations to take a lead in promoting

ethical scientific behavior. The Pugwash organization's work on sensible nuclear policy is a strong example.

But what will get the scientific community to accept being told what to do?
Catastrophe. We have scientists saying they want to publish pathogen gene sequences on the Net. One consequential accident and we'll want to throw those researchers in jail.

So much for progress.
What are we in such a hurry for?

Easy for you to say. You live in Aspen.
We don't need a lot of economic growth to address the problem of the world's poor. We put subsistence farmers out of business because that's our choice. Clean water would do more to alleviate disease than high tech medicine.

Downsizing expectations? That's pretty pessimistic.
I'm not a pessimist. Democracy is about individuals giving up the ability to do whatever they want so that everybody can have some rights. We may have to give up some of the power of high technology if we want to keep our civil liberties. And that is a choice, whether we realize it or not.

Tell that to the happy workaholic hordes of Silicon Valley or Wall Street.
Hey, I quit my job.

All right, you win. What are you doing for fun these days?
I'm figuring out a meditation wall for my apartment in New York. Eight feet high by 12 feet wide, with an array of overlapping rear projectors, each with a tiny Linux box and connected by gigabit Ethernet. I would love to get 72 dpi but will probably settle for less – about 30 megapixels for the whole thing. [Former Walt Disney Imagineering guru] Bran Ferren and Danny Hillis [inventor of massively parallel supercomputing] at Applied Minds are building it for me. It's very bright. Given that it's in an apartment, the main limitation will be power availability. I'll also need some great 30-megapixel images. Any ideas? I can always put a picture of stars on the wall. In Manhattan, you can't see them – except, of course, in a blackout. ■ ■ ■

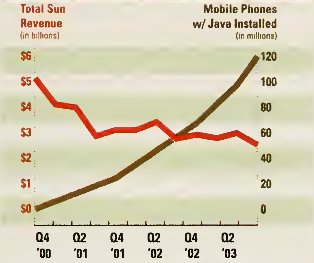
Reheating Java

Facing tough times, Sun looks for a new source of cash.

by Kevin Kelleher

GOING HAND-TO-HAND

While touted as a success, Java has produced little revenue for Sun. Now the company is counting on Java-based mobile handsets to bolster the bottom line.



Sources: Bloomberg, Sun Microsystems

Introduced by Bill Joy and a team of Sun engineers in 1995, Java was hailed for its ability to run software applications on any platform. Half programming language, half operating system, Java has lived up to its billing – breathing life into Web browsers, bridging incompatibility gaps, and, lately, giving us videogames on our cell phones.

What can't Java do? For starters, make Sun any real money. After eight years, the only significant income the company gets from Java is from licensing – a mere penny or two of every dollar of Sun revenue.

From the beginning, Sun intended Java to be primarily a loss leader for hardware. The more Java-enabled Web sites there were and the greater the number of programmers using Java for ecommerce software, the bigger the (perceived) need for Sun's high-end Web servers. The company made the decision not to sell Java by itself for fear of cutting into server sales.

For a while, this strategy worked fine. In the late '90s, Java helped sell untold Sparc servers – untold because Sun's not saying. But then Dell came along and cut Sun off at the knees with cheap servers running Linux software. IBM and BEA Systems, meanwhile, latched on to Java and sold it in the lucrative market for application server software, which helps link computers to back-end databases over the Web. Today, those companies own a majority of the $3.9 billion annual business. "When Java hit, it was the greatest thing since canned beer," says John Rymer, a vice president at Giga Information Group. "Sun began with the upper hand, but it lacked a software strategy that was worth a damn."

Now, with its expensive servers out of vogue and revenue half of what it was a few years ago, Sun is trying to make Java pay off. That's why the company is jumping into the Java-based application market that it shrugged off in the late '90s. The strategy: price war. Sun wants to do to IBM, BEA, and Oracle on the software front what Dell did to Sun in hardware.

Under the fancy label Java Enterprise System, Sun has created a Java-based software package – Web server applications, email management, ID authentication – that it's pushing to the corporate world at the low, low price of $100 per employee. Jonathan Schwartz, Sun's executive VP of software, claims the fee (a fraction of what market leaders charge) will make Sun "the Wal-Mart of software," winning in market share what it loses on price.

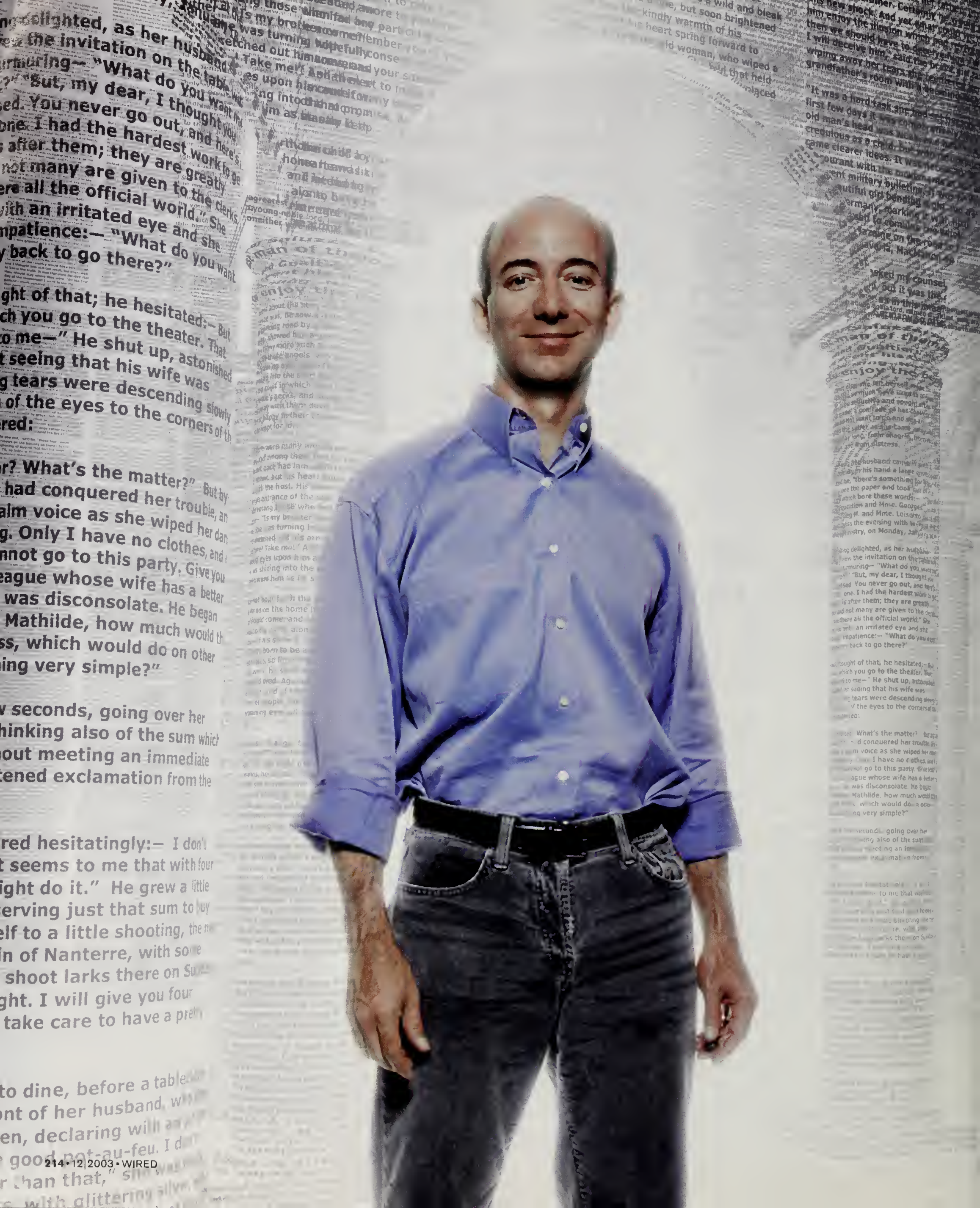
Because no Sun strategy is complete without an anti-Microsoft component, the company has reassembled a Java desktop package – a Mozilla browser and Star-Office applications – also priced at $100.

Will the new approach work? Hotels.com director of architecture Brad Schneider likes the pricing scheme for the Java Enterprise System, but his bosses are freaked out about buying from a company they think could go under any day now. "People talk about Sun like it might have the doors chained," he says.

Sun also has a consumer strategy for Java. The company is starting a cell phone branding ploy à la "Intel Inside." Nearly 120 million mobile phones use Java to download games, mostly in Europe and Japan. Sun foresees phone manufacturers and service providers promoting the "Java Powered" tagline to their customers.

If the flurry of activity reeks of desperation, well, these are desperate times. Sun's stock is off 95 percent from its 2000 high and its prognosis is somewhere between deathwatch and takeover. "Should we have done this earlier?" asks John Loiacano, VP of Sun's Operating Platform Group. "Of course we should have." ■ ■ ■

Kevin Kelleher (kpk99@yahoo.com) *profiled the Wired 40 companies in* Wired 11.07


ng delighted, as her husband
w the invitation on the table
rmuring— "What do you want
?" "But, my dear, I thought you
sed. You never go out, and here's
one. I had the hardest work to ge
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not many are given to the clerks
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ght of that; he hesitated:— But
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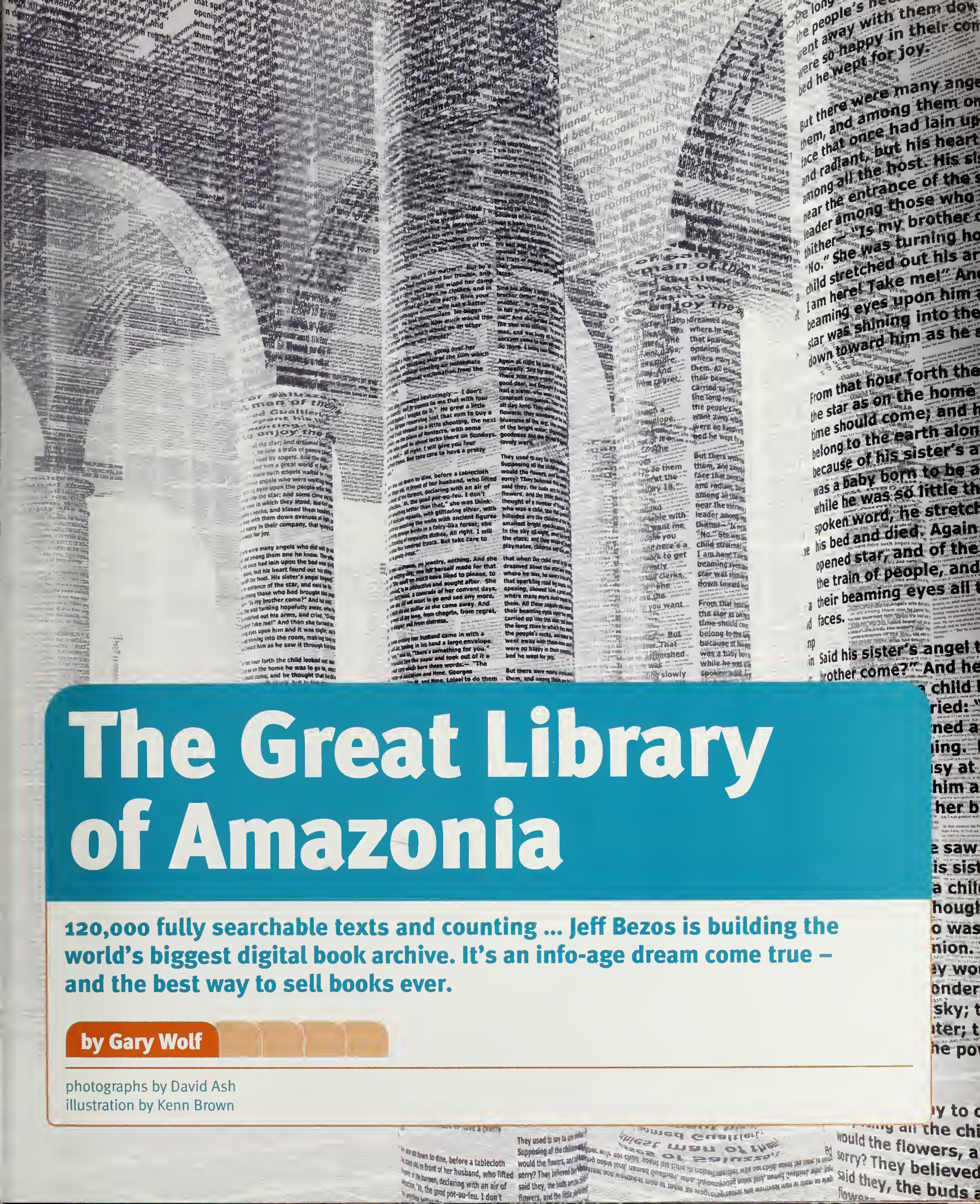

The Great Library of Amazonia

120,000 fully searchable texts and counting … Jeff Bezos is building the world's biggest digital book archive. It's an info-age dream come true – and the best way to sell books ever.

by Gary Wolf

photographs by David Ash
illustration by Kenn Brown

The fondest dream of the information age is to create an archive of all knowledge. You might call it the Alexandrian fantasy, after the great library founded by Ptolemy I in 286 BC. Through centuries of aggressive acquisition, the librarians of Alexandria, Egypt, collected hundreds of thousands of texts. None survives. During a final wave of destruction, in AD 641, invaders fed the bound volumes and papyrus scrolls into the furnaces of the public baths, where they are said to have burned for six months. "The lesson," says Brewster Kahle, founder of the Internet Archive, "is to keep more than one copy."

Kahle recently gave a copy of his digital archive of 10 billion Web pages to a new library in Alexandria. On a visit to the city last year, he sat down with Suzanne Mubarak, the wife of Egypt's president, and discussed his gift, which has all the advantages of a modern electronic resource: It can be instantly updated, easily searched, and endlessly replicated. Mubarak, with diplomatic politeness, allowed that she was impressed. Still, she ventured a protest: "But I love *books*!"

Therein lies a problem. Books are an ancient and proven medium. Their physical form inspires passion. But their very physicality makes books inaccessible to the multiterabyte databases of modern Alexandrian projects. Books take time to transport. Their text vanishes and their pages yellow in a rash of foxing. Most important, it's still shockingly difficult to find information buried in books. Even as the Internet has revived hope of a universal library and Google seems to promise an answer to every query, books have remained a dark region in the universe of information. We want books to be as accessible and searchable as the Web. On the other hand, we still want them to be books.

My query turns up a few titles, then suddenly I'm deep into the pages of *American Psycho*. I'm captivated.

An ingenious attempt to illuminate the dark region of books is under way at Amazon.com. Over the past spring and summer, the company created an unrivaled digital archive of more than 120,000 books. The goal is to quickly add most of Amazon's multimillion-title catalog. The entire collection, which went live in late October, is searchable, and every one of the 33 million pages is viewable.

To build the archive, Amazon CEO Jeff Bezos has had to unravel a tangle of technological and copyright problems. His solution promises to remake the publishing business and give Amazon a powerful new weapon in its battle against online competitors such as Yahoo!, Google, and eBay. But the most interesting thing about the archive is the way it resolves the paradox of the book, respecting its physical form while transcending its limits.

I recently drove to a home in Silicon Valley and spent a few hours digitally searching the text of books. My host was Udi Manber, an Israeli-born computer scientist and author of a popular textbook, *Introduction to Algorithms: A Creative Approach*. Ten years ago, while developing a seminal piece of Unix search software called agrep, Manber came up with a concept for an information tool he has yet to build. It was supposed to search the mess of papers on his desk. The idea that you could perform a digital search of physical objects has long fascinated him. "Why not have users take pictures of their bookshelf?" Manber asked when we first met. "We could scan the images, extract the titles, and then let them search the entire text of the books they own."

The notion of Amazon scanning all of its books but allowing users to search only those they own is a clever way around the central barrier to creating a digital archive: Copyrights are distributed among tens of thousands of publishers and authors. But when Manber told Bezos his idea, he found the Amazon founder ready to work on a grander scale. Bezos wanted his customers to be able to search everything.

In his small, ranch-style Palo Alto house, Manber and I sit side by side at a table near the kitchen as he begins typing my queries into his laptop. The computer is connected to a prototype of the archive, which at the time of my visit is scheduled to go live in a few weeks. Within seconds, I am captivated. The experience reminds me of how I felt a decade ago, when I first began browsing the Web. Back then, the Web was still small, and most of my time was spent peeking into the homepages of physicists and engineers. Even so, the power of the new network was unmistakable. The thrill didn't come from the content of the pages but from the structure of the Web itself, its obvious scalability and ease of navigation.

Amazon's new archive is more densely populated than the early Web was, but it's still far from complete. With its 120,000 titles, the archive has about as many books as a big brick-and-mortar store. Still, this is plenty to create a familiar sensation of vertigo as an expansive new territory suddenly opens up.

The more specific the search, the more rewarding the experience. For instance, I've recently become interested in Boss Tweed, New York's most famous pillager of public money. Manber types "Boss Tweed" into his search engine. Out pop a few books with *Boss Tweed* in the title. But the more intriguing results come from deep within books I never would have thought to check: *A Confederacy of Dunces*, by John Kennedy Toole; *American Psycho*, by Bret Easton Ellis; *Forever: A Novel*, by Pete Hamill. I immediately recognize the power of the archive to make connections hitherto unseen. As the number of searchable books increases, it will become possible to trace the appearance of people and events in published literature and to follow the most digressive pathways of our collective intellectual life.

From the Hamill reference, I link to a page in the afterword on which he cites books that influenced his portrait of Tweed. There, on the screen, is the cream of the research performed by a great metropolitan writer and editor. Some of the books Hamill recommends are out of print, but all are available either new or used on Amazon.

With persistence, serendipity, and plenty of time in a library, I may have found these titles myself. The Amazon archive is dizzying not because it unearths books that would necessarily have languished in obscurity, but because it renders their contents instantly visible in response to a search. It allows quick query revisions, backtracking, and exploration. It provides a new form of map.

Getting to this point represents a significant technological feat. Most of the material in the archive comes from scanned pages of actual books. This may be surprising, given that most books today are

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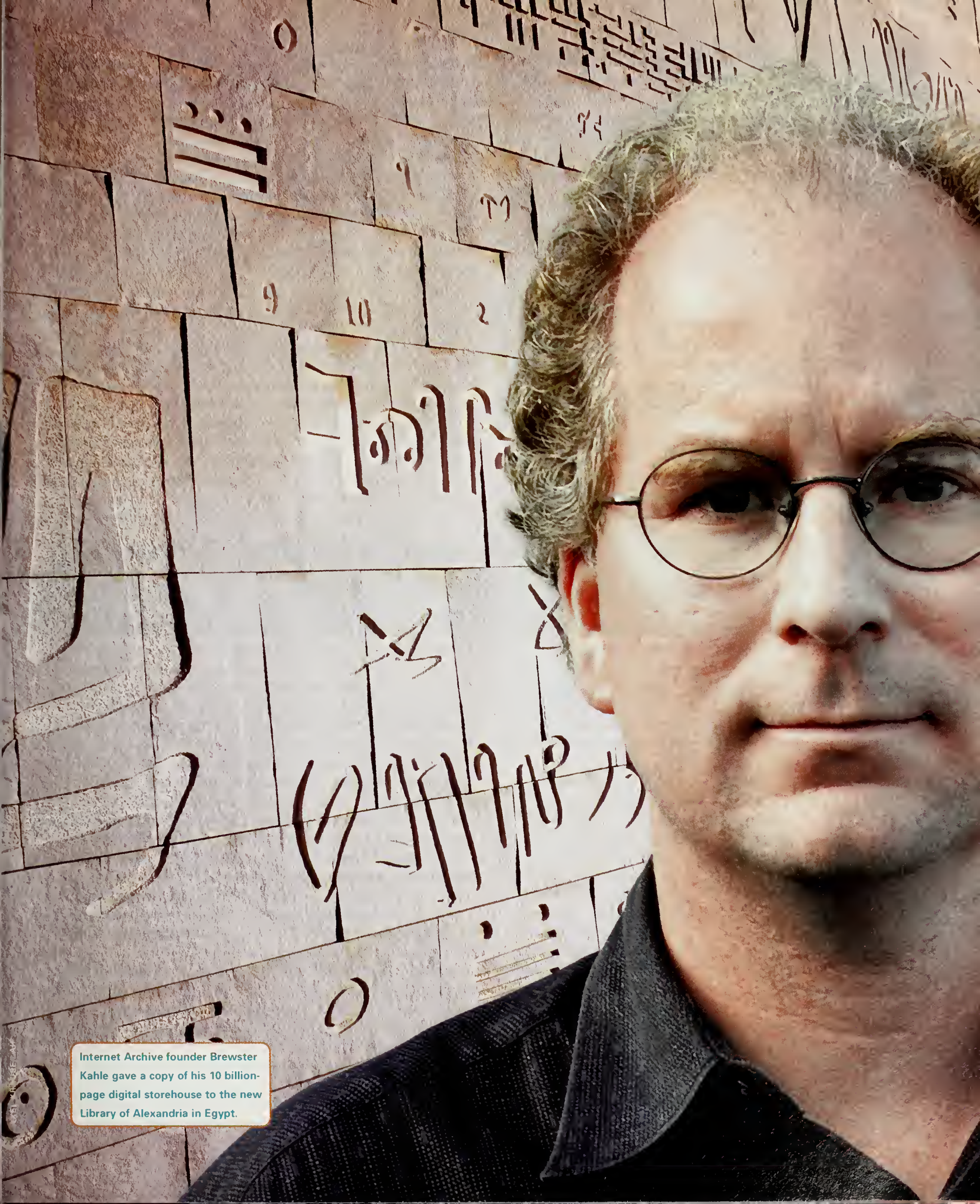
Contributing editor Gary Wolf (gary@aether.com) *is the author of* Wired: A Romance (*Random House*).



Internet Archive founder Brewster Kahle gave a copy of his 10 billion-page digital storehouse to the new Library of Alexandria in Egypt.

written on PCs, emailed to publishers, typeset on computers, and printed on digital presses. But many publishers still do not have push-button access to the digital files of the books they put out. Insofar as the files exist, they are often scattered around the desktops of editors, designers, and contract printers. For books more than a few years old, complete digital files may be lost. John Wiley & Sons contributed 5,000 titles to the Amazon project – all of them in physical form.

Fortunately, mass scanning has grown increasingly feasible (see "3 Ways to Scan a Library," opposite page), with the cost dropping to as low as $1 each. Amazon sent some of the books to scanning centers in low-wage countries like India and the Philippines; others were run in the US using specialty machines to ensure accurate color and to handle oversize volumes. Some books can be chopped out of their bindings and fed into scanners, others have to be babied by a human, who turns pages one by one. Remarkably, Amazon was already doing so much data processing in its regular business that the huge task of reading the images of the books and converting them into a plain-text database was handled by idle computers at one of the company's backup centers.

The copyrights to these titles are spread among countless owners. How was it possible to create a publicly accessible database from material whose ownership is so tangled? Amazon's solution is audacious: The company simply denies it has built an electronic library at all. "This is not an ebook project!" Manber says. And in a sense he is right. The archive is intentionally crippled. A search brings back not text, but pictures – pictures of pages. You can find the page that responds to your query, read it on your screen, and browse a few pages backward and forward. But you cannot download, copy, or read the book from beginning to end. There is no way to link directly to any page of a book. If you want to read an extensive excerpt, you must turn to the physical volume – which, of course, you can conveniently purchase from Amazon. Users will be asked to give their credit card number before looking at pages in the archive, and they won't be able to view more than a few thousand pages per month, or more than 20 percent of any single book. Manber has built a powerful, even mind-boggling tool, then added powerful constraints. "The point is to help users find a book," says Manber, "not to make a new source of information."

> **A digital library is good for conventional publishing, Bezos insists. "Our goal is to sell more books!"**

Bezos is vehement on this point. He has sold publishers on the idea that digitizing hundreds of thousands of copyrighted books won't undermine the conventional bookselling business. "It is critical that this be understood as a way to get publishers and authors in contact with customers," he says in an interview at Amazon's Seattle headquarters. "We're perfectly aligned with these folks. Our goal is to sell more books!"

Bezos has some good evidence to back up his argument. Amazon has consistently added features that have proven to increase book sales. Through its customer reviews, used-book business, and personalized recommendations, the company constantly puts its customers in contact with new titles. Amazon is a machine that stimulates the acquisitive urge of readers. It appeals to their specialized interests. It makes people buy books. But Amazon's scheme would never work if users really wanted their books in digital form. The magic of the archive lies in the assumption that physical books are irreplaceable. The electronic text is simply an enhancement of the physical object.

The Amazon project – dubbed Search Inside the Book – represents a bold step toward the dream of a universal library. Bezos refuses any such allusion. But outlines of the Alexandrian fantasy can clearly be made out in Amazon's innocent book-purchasing tool. The company's success at launching a massive archive of digital books will undoubtedly fuel enthusiasm for overturning the current publishing and copyright regime.

I first talked with Brewster Kahle a dozen years ago over a plate of execrable spaghetti in the kitchen of a flat in San Francisco's Mission District. The apartment served as the headquarters of WAIS, one of the first Internet search engines, and Kahle was sharing a dinner with me and several of his employees. He was in his twenties then – thin, with a mass of unruly curly hair, a rapid manner of speech, and an unguarded expression. Kahle was already one of the great enthusiasts of universal information access. A few months earlier, he had left his job at Thinking Machines, the legendary builder of massively parallel supercomputers, and devoted himself full-time to refining and selling WAIS.

To Kahle, it was obvious that vast amounts of useful material could be shared with the general public via computers, but the Web did not yet exist, and most of the major databases were not linked. You couldn't do a comprehensive search. WAIS was meant as a remedy, and it proved a modest success. However, its most significant contribution to Kahle's evangelical mission was a byproduct of the stock market bubble: In the spring of 1995, AOL bought WAIS for $15 million in stock. AOL stock soared, and Kahle became rich.

With his money, Kahle started the Internet Archive, while also creating another company that offered a clever Web search tool called Alexa. In 1999, as the bubble continued to expand, Alexa was sold to Amazon for $250 million in stock, and Kahle became richer. He's now committed to public service. The computers of the Internet Archive are in a Mission District warehouse. The headquarters are in a ramshackle house in the Presidio, a decommissioned Army base near the Golden Gate Bridge. The office is one of those classic engineer-idealist domains, where programmers go up the fire stairs because the inside stairs are broken, and age-old pizza molders in the refrigerator.

When I call Kahle to ask if I can come talk to him about the state of digital libraries, he says, "Sure, I'm free right now." I find him substantially the same. "What's the average lifespan of a Web page?" Kahle asks me when we meet, and then answers himself: "One hundred days!" He has a slightly accusatory tone, as if I share in the general neglect that led to the erasure of history – or would, if the machines owned by the Internet Archive weren't so busily preserving it.

The goal of the archive is to save digital information and make it accessible to all. But what, exactly, is digital information? As the entertainment industry has learned to its great chagrin, digital information might take the form of music, or movies, or even books. To Kahle, this is a good thing. The products of human knowledge ought not to be squirreled away where they can't ever be found.

Kahle hates the idea that when people think of information, they think only of what's accessible via Google. "Seventy-one percent of college students use the Internet as their research tool of first resort," he says, citing figures from a 2001 PEW Internet Study. "Personally, I think this number is low. For most students today, if something is not on the Net, it doesn't exist."

And yet most books are not on the Net. This means that students, among others, are blind to the most important artifacts of human knowledge. For many students, the Internet actually contracts the universe of knowledge, because it makes the most casual and ephemeral sources the most accessible, while ignoring the published books. "It's shameful," Kahle continues, "because we have the tools to make all books available to everybody. You need three things. Technically, you need storage and connectivity. Storage is easy. For under $10 million, you can store all published works of humankind back to the Sumerian tablets. The last time they tried this was in Alexandria, and they had an innovative storage mechanism, too. They had papyrus, and papyrus was astonishing compared to clay tablets. But we can do better than the Alexandrians, because we also have connectivity. I have traveled in Uganda and in rural Kenya and seldom been more than one day's walk from an Internet café. It is technologically possible for most kids in the world to have access to all the books in the world."

The third item on Kahle's list has nothing to do with technological know-how; it's simply political will. Here, he finds the situation mixed. "We live in an open society in which the concept of widespread knowledge is embraced as a goal of governance," he says. "Just look at our libraries. Public libraries spend $7.6 billion a year; academic libraries spend another $5 billion." That's the good news. The budgets are hard evidence of a public commitment to the Alexandrian ideal. But on the other hand, almost none of this money goes to digitizing books.

The Internet Archive turned Kahle into an expert in managing huge databases of publicly accessible information. Now – in partnership with Carnegie Mellon University, the National Science Foundation, and the governments of India and China – his goal is to create a digital archive of 1 million books. Books from the US are packed into containers and shipped to India to be scanned and proofread, then the digital files go to the Internet Archive and the books are returned to the owners. Kahle and his partners are hoping to have about 100,000 online by the end of the year, making this project almost as big, at least numerically, as Amazon's effort. "We chose a million books because it's a big number," admits Kahle. "It's something you can strive for."

But in reality, the Million Book Project lags far behind Amazon's effort. For one thing, libraries have been slow to lend parts of their collections. And even then, the project concentrates on digitizing those that are out of copyright. Libraries and nonprofits don't have much leverage with publishers, and since the goal is fully readable online text, there is no system to protect the interests of copyright holders. As a result, many of the titles being digitized by the Million Book Project are government documents, old texts, and books from India and China, where copyright laws are less stringent.

Kahle is happy to sidestep the problem of digitizing commercially successful books. He has no wish to antagonize the publishing

NAMAS BHOJANI

A book-scanning center in Bangalore, India.

3 Ways to Scan a Library

Books today are written on laptops, typeset on PCs, and pumped out on digital presses. But ironically, the most efficient way to create an electronic library is to scan the printed page. The technology has come a long way since the days of the Kurzweil machines – hulking, 1-ton scanner/optical character recognition combos that emerged in the early 1980s. Today, the biggest archiving projects use some combination of these three methods. – **Dustin Goot**

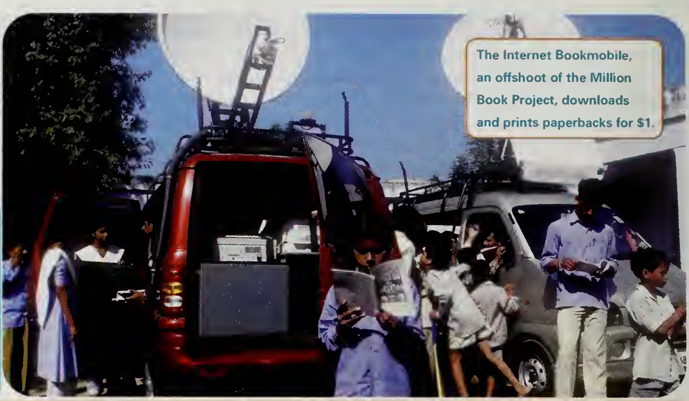
Tear Off the Spines Using a paper guillotine (which looks just like its Bastille cousin), a book's pages are simply lopped off of the binding and sent through a scanner with an automatic page feeder. High-end machines cost $25,000 and churn through 90 black-and-white pages per minute, front and back. Rare books need not apply.

Ship It Overseas Workers in India, China, and the Philippines earn about 40 cents an hour to manually turn pages that are zapped by $15,000 overhead scanners. Carnegie Mellon's Million Book Project alone employs more than 100 Indians for this activity. The Indian government views it as a boon to local employment.

Hire a Robot Flipping pages is more complicated than meets the eye, but robots are getting the hang of it. Earlier this year, Kirtas Technologies introduced a bot that has both an overhead scanner and an automated page-turning arm. While a book sits open in a special cradle, the arm swoops down, grabs the top page with gentle suction, and turns it. The machine boasts a speed of 1,200 pages an hour, but justifying its six-figure price to frugal librarians is tough.

The Digital Book Brigade

Amazon's Search Inside the Book project is not the only effort to bring the bookshelf to the desktop – it's just the biggest. From legions of volunteers typing in single pages to small-town contributors translating their personal libraries into myriad languages, a handful of pioneers have blazed the digital book trail. – **Erik Malinowski**



The Internet Bookmobile, an offshoot of the Million Book Project, downloads and prints paperbacks for $1.

NAMAS BHOJANI

Initiative	Launched	Books digitized	Goal	What's in it	Who's behind it
Amazon.com's Search Inside the Book	2003	120,000	"Millions"	A cross-section of popular titles	Amazon.com
Project Gutenberg	1971	10,000	1 million	Classics – as long as they're not copyrighted	The nonprofit Literary Archive Foundation
Million Book Project	2001	10,000	1 million	Government docs, old titles, books from India	National Science Foundation, Carnegie Mellon
International Children's Digital Library	2002	262	10,000	Domestic and international children's books	NSF, Institute for Museum and Library Services, University of Maryland
Children's Books Online: The Rosetta Project	2000	119	4,500	Antique children's books from around the world	Nonprofit foundation relying on individual private donations

industry. What he hates is that the Million Book Project cannot legally digitize countless books that aren't generating money for anybody. US libraries hold about 30 million unique volumes. No one knows how many of those books continue to be protected by copyright or are available from commercial publishers. Still, Kahle says, "they can't be digitized because the copyrights can't be cleared, and the copyrights can't be cleared because it's too much work to identify the copyright holders. Some people call them abandonware. I call them orphans."

"Amazon is taking a cut at the commercially available titles," continues Kahle. "We are going for the public domain titles. But who is taking care of the orphans? Nobody."

This is no longer true. Kahle's plea on behalf of orphaned books, stripped of its sentiment and restated in the rational voice of finance, exactly expresses the logic of Amazon's Alexandrian venture. Latent within the new archive is a business model for selling books that, with a little legal help, ought to vanquish orphanhood forever.

The publishing industry has made great strides since the Roman era. Movable type was invented in 11th-century China, then reinvented in 1450 in Germany. In 1886, Ottmar Mergenthaler created an automatic typesetting machine. In 1983, we got desktop publishing. But publishers continue to edit books using four colors of pencil, and the idea of freely accessible digital files conjures nightmares of a peer-to-peer disaster among media corporations. Things are even going backward – Barnes & Noble recently announced it would stop selling ebooks.

In this context of change, confusion, and fear, Jeff Bezos is forced to behave like a politician. Talk of a universal library elicits no enthusiasm from him. When I mention it, he counsels caution and patience. "You have to start somewhere," he says. "You climb to the top of the first tiny hill, and from there you see the next hill. It's difficult to see what's beyond before you have climbed the first hill."

When I met Bezos the first time, in 1996, there was no masking the radical nature of his ideas. At the time, he was trying hard to prove that you could create a major retail company on the Web. Skeptics abounded, and he answered them with vivid descriptions of the future. All of Amazon's important innovations – starting from the concept of a Web bookstore – have suggested a profound change in the bookselling business, a change that makes it possible to earn a profit by selling a much wider variety of books than any previous retailer, including many titles from the so-called long tail of the popularity curve. "If I have 100,000 books that sell one copy every other year," says Steve Kessel, an Amazon VP, "then in 10 years I've sold more of these, together, than I have of the latest Harry Potter."

In fact, Amazon doesn't have to wade far into the shallows to begin remaking the book business. Books are abandoned by publishers long before their sales are reduced to one copy every other year. Under the current publishing system, a title becomes inefficient at thousands of sales per year. An electronic archive through which readers can *find* books is an essential counterpart to Bezos' original vision of an infinitely big bookstore, just as Internet search engines are essential to the fragmented, increasingly diverse cultures of the Web.

This vision implies that readers will someday be able to purchase books that are printed at the time they are ordered. On a small scale, that phase of the revolution has already been quietly accomplished. As part of the Million Book Project, Kahle has created an Internet Bookmobile that produces decent-quality paperbacks of out-of-copyright books for about $1 each. The bookmobile consists of a Ford Windstar minivan with a satellite dish, a computer, a printer, and a binder. Meanwhile, last spring, Amazon announced a partnership with Ingram Industries' Lightning Source subsidiary, a print-on-demand company that offers more than 100,000 titles – with a list that grows by hundreds each week. Lightning Source is the high end, Kahle's Internet Bookmobile is the low end; both operate on the premise that tiny runs of books can be affordably made and sold.

With these tools, the concept of *out of print* is becoming obsolete. A copyright-friendly archive that allows all books to be easily found plus a books-on-demand printing network gives publishers an economic motive for reactivating entire back catalogs. As for books whose copyright holders cannot be found – Kahle's orphans – this is where the copyright law needs to change. A sensible solution advanced by copyright scholar (and *Wired* columnist) Lawrence Lessig and written into a bill before Congress requires that copyright be renewed every 50 years for a token sum. Anybody who can't be bothered to pay a dollar or two to hold on to a copyright loses the work to the public domain.

Someday soon, everything will be search, purchase, print on demand – and "out of print" will be obsolete.

And who will digitize the books once they've been claimed by their copyright holders or lapsed into the public domain? Project Gutenberg, the first book-digitizing initiative, has put about 10,000 titles online and is rapidly accelerating its effort. The Million Book Project, launched by Carnegie Mellon computer scientist Raj Reddy, is eager for more volumes. Lessig, in partnership with Stanford University librarian Michael Keller, will soon announce a free program to digitize any out-of-print book whose copyright holder wants to make it available to the public. And of course, Manber invites copyright holders to offer nonexclusive searching and browsing rights to Amazon, which will digitize the titles and offer access to audiences forever. "Give the books to me," Manber says. "I am glad to do it."

The original vision of a digital archive of all knowledge renounced paper volumes; physical books were seen as antiquated, like papyrus or clay tablets. But if electronic archives prove to raise the value of physical books, a new dream may replace the old one. After talking with Manber, I raise this question with Kevin Kelly, a *Wired* founding editor who spent part of his summer trying to establish a private cooperative library of digital books. The digital titles in Kelly's library would match the physical books on his shelf. "The idea of ebooks was to do away with paper," he says. "But really, you want to add dimensionality to a physical object rather than take it away. You want an enhanced physical world."

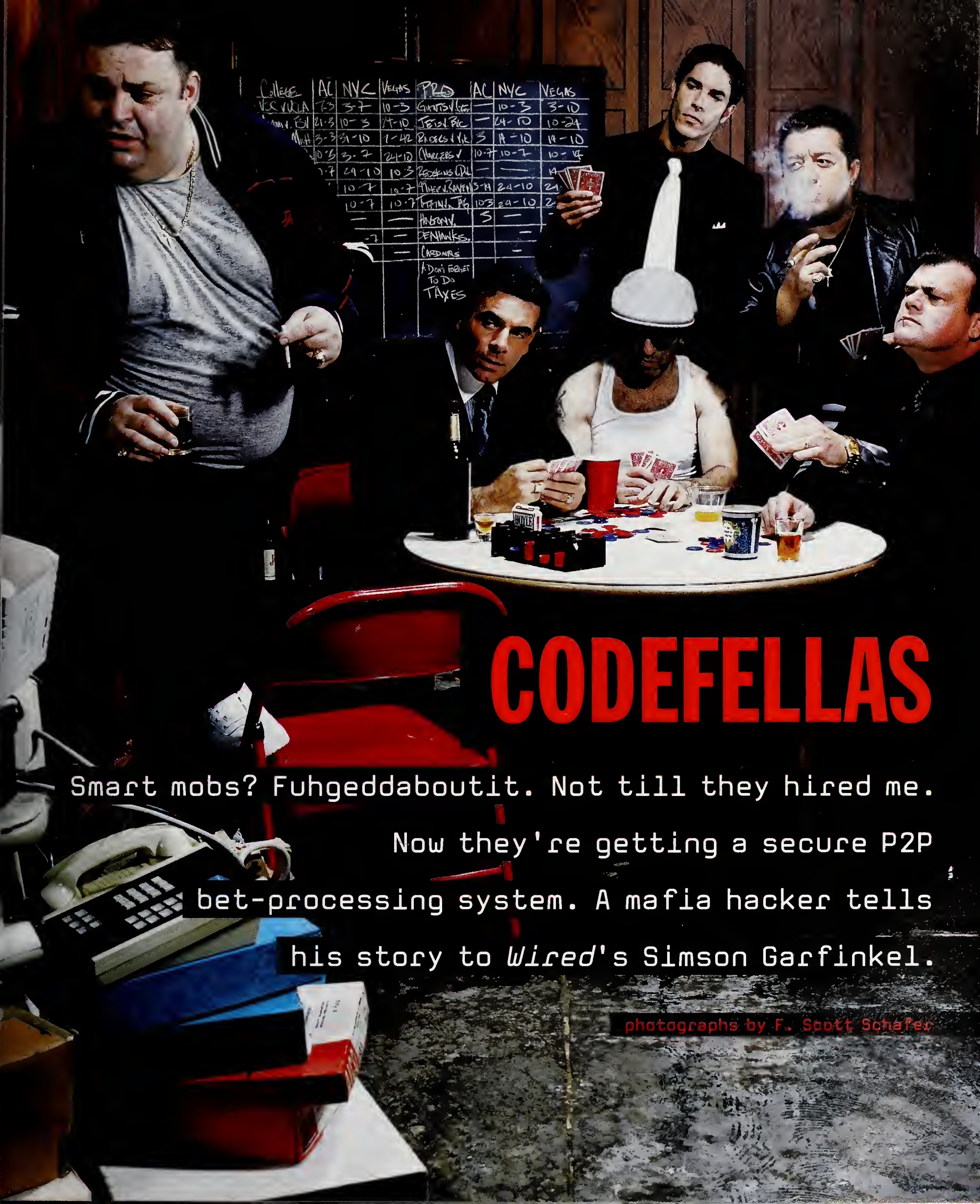
In this enhanced physical world, the logic of the book business is transformed. Human attention is limited, and a massive number of newly browsable books from the long tail necessarily compete with the biggest best-sellers, just as cable siphons audience from the major networks, and just as the Web pulls viewers from TV. This shifts power away from the people who own finite sets of copyrighted material and toward the people who offer access to information about where this material can be found. Information about books, not ownership of copyrights, becomes a new center of power. Manber is correct when he says that Amazon's Search Inside the Book is not an ebook project. It is merely a catalog. But a decade of Internet history proves that the catalog is exactly what you want to own.

Of course, Amazon is not merely part of the book business. The Internet as a whole is going through a similar transition. Revenue for Internet companies increasingly comes from users seeking to buy something – from transactions made in the physical world. Even Google, which doesn't sell anything directly, earns most of its cash from advertisers whose messages pop up when users search for info about specific products, such as computers or cars – or books. With retail at the center of the Internet industry, Google is a key competitor because customers begin their online shopping trips at search engines that offer neat algorithms for comparing prices across multiple vendors. Everybody – Yahoo!, eBay, AOL, Microsoft, and, of course, Amazon – wants to be the site of first resort.

All the leading retail sites have better knowledge of their customers than Google. But Google is the leading Internet information tool, period. Google is a window onto the entire Web. On the other hand, the contents of books may be the only publicly accessible data set with the potential to match Google's Web index both for size and utility. Search Inside the Book makes Amazon the sole guide to tens and ultimately hundreds of millions of pages of information. And while Google's business is vulnerable to any competitor that builds a better search engine, Amazon's book archive is the product of negotiated contracts with hundreds of publishers. Amazon has cornered the market on information that was once hidden away in books. The burden of the physical – the fact that the database Amazon uses is linked into a complex system involving real things – gives it a stunning, if perhaps temporary, advantage.

This fall, Amazon announced that it was forming A9.com, a new company devoted exclusively to search technologies. Manber, who leads it, came up with the name by running a simple compression algorithm on the word *algorithms*. *Algorithms* begins with *A* and is followed by nine other letters. When Manber explains the name to me, he notes mischievously that another word can be identically compressed: *Alexandria*.

Amazon's Alexandrian scheme hinges on the insight that physical books can be turned into electronic databases and then – in the retail process – turned back into physical books. This is one of the boldest maneuvers yet in an intense commercial competition, but for all its cunning, this is a civilized, even civilizing war, one that builds libraries rather than burns them. ■ ■ ■



CODEFELLAS

Smart mobs? Fuhgeddaboutit. Not till they hired me. Now they're getting a secure P2P bet-processing system. A mafia hacker tells his story to *Wired*'s Simson Garfinkel.

photographs by F. Scott Schafer

On a traffic-clogged street in midtown Manhattan – sandwiched among the bars, massage parlors, and cheap diners – there's a small glass door that leads to my office. The building has no doorman, no front desk, and no video surveillance cameras. We don't go in for that type of security. I walk through the door, down a long corridor to an elevator. When I press the button, the elevator starts with a jump, and a bell on the third floor rings. Now the boys upstairs know that someone's coming.

The bell is a warning: *It could be the police, so get ready to run.* But even if the cops come, they'll be waylaid by an imposing lock – giving my friends time to scramble down the fire escape to the street below.

Of course, I've got a key. I unlock the door and enter another world. Inside is a small-scale gambling operation the likes of which you'll find scattered all over the city – if you know where to look. I scan the room to see who's there. Most days, there are three middle-aged men sitting at desks, talking on phones so old that they could have been used on the set of *Lou Grant*. We're talking first-generation touchtone sets with big square buttons that light up when a line is in use.

Today there's just Tony. He glances over his shoulder and nods at me. "Let me check," he mutters into the phone. He peers intently at the screen of a rather beat-up PC and eyeballs the odds for one of today's baseball games. We track four casinos in Las Vegas and set our odds by averaging theirs. The casinos might be offering a $150 return on a $100 wager if, say, the Red Sox beat the Yankees. Tony scrolls down and gives him the line. There's a pause. Then he smiles. The caller likes the odds. "OK, how much?" Tony scribbles a few numbers on an index card and hangs up. The tape recorder shuts off. Like a brokerage house, we record every conversation – just in case there's a dispute with one of our customers. Of course, you never hear about those disputes: The entire transaction between Tony and the caller is illegal. If he accepts four more bets today, he's in felony territory, an offense punishable by up to three years in prison.

Tony looks up. "That's the first call I had all morning," he says. A few more mouseclicks and he's back to solitaire.

Everyone thinks they know what the mob is like. It's something you learn from watching *The Sopranos* and *GoodFellas*, something that involves Joe Pesci, baked manicotti, and a dead guy in the trunk. But that's not what I've seen during my two years working for organized crime. My sense is that the mob works a lot like GE or Time Warner. It's more Jack Welch than John Gotti.

When a so-called mobster gets caught, the cops always lie, and the journalists believe what they're told. The cops will say that millions of dollars move through offices like mine, and that all of the money goes to some big crime family. It makes great headlines, but it's laughably untrue. Perhaps we move millions of dollars over the course of a year, but we keep only a small percentage of that – "the juice." The rest gets paid out as winnings, at better odds than you'll find in any legitimate game of chance.

Then there's the misconception that if you don't pay your debts, the mob will break your legs. I've seen that on TV but never in real life. Sure, some agents make their collection runs with a bodyguard, but wouldn't you want some muscle around if you were carrying tens of thousands of dollars in cash? Breaking people's legs is bad business. If somebody doesn't pay their debts because they're broke, maiming them isn't going to put cash in your bank account. Still, the threat of pain remains a valuable deterrent. Tell your customers that you're breaking people's legs and there's no reason to actually do it. Truth is, when people don't cover their debts, we put them on a payment plan. If that doesn't work, we spread the word that they're a bad risk. Basically, we fuck up their underground credit rating.

The whole business of taking bets and paying out is based entirely on trust. The wagers are a form of credit, advanced on trust between the agent and the players. The people placing the bets trust that they'll get paid if they win. Everyone trusts that nobody is going to call the cops. It works because everything is compartmentalized – people keep to themselves, just like stock traders don't socialize much with construction workers.

My job is a lot like managing any other venture. I make sure that people show up on time, that bills get paid, and that the customers and employees are reasonably happy.

But that's not all I do. I'm tech support for the mob. From the moment I started this gig, I realized just how behind this gang is when it comes to technology. Forget about the paperless office.

Contributing writer Simson Garfinkel (slg@ex.com) *covers computer security and crime.*

PRODUCTION: BERNS ROTHCHILD; STYLIST: JILL TOPOL; SET DESIGNER: LINDA KEIL; HAIR: BRIAN MAGALLONES FOR ARTIST LOFT; MAKEUP: JASON PAULSON

These guys are buried in pulp. But when they want to revamp their systems, it's not like they can call McKinsey for advice. That's where I come in.

I'm building a secure, online, peer-to-peer, encrypted, redundant bet-processing system with an offshore data warehouse. Ordinary companies would hire a team to put this together; I'm working with one guy. Getting the system up and running is a three-step process. First, eliminate all those incriminating little pieces of paper. Instead of writing down a wager, the operator will enter the bet onto an online form. The whole transaction will be encrypted by a browser and sent over the Net to a server running in an undisclosed country where the laws are more liberal than they are in the US. Essentially, the system acts as a market maker, matching up people who want to take different sides of a sports bet.

You think IBM needs encryption to protect its assets? Our back-end servers will all be based on Mandrake Linux, one of the few versions of Linux that offers encryption for both user data and the swap partition. When you reboot, you'll have to log in and type a password to bring up the database and applications. The final system will have not one but three servers, all located in different jurisdictions. Each transaction will be recorded at two servers for redundancy. The entire system will be backed up by S/MIME-encrypted email sent from each system to dead-drop mailboxes located somewhere else on the planet – a place where sports betting is legal.

The second step is to move beyond matching up two bettors and program the computer to take a side when no one is willing to take theirs.

Finally, we'll be moving to voice over IP. With our operators working out of their homes using cable modem or DSL – as a modern employer, we have to offer a flexible work environment – it's a simple matter to run voice over the same high-speed line. This has the advantage of eliminating all those traceable phone calls while simultaneously letting us encrypt our voice communications.

A few years ago, then FBI director Louis Freeh warned Congress that if encryption technology wasn't controlled, drug dealers, organized criminals, terrorists, and child pornographers would soon be using it to protect their records. Freeh was half right. We are using encryption, but we'd be using it even if it was illegal. The fact that it's built into the operating system just makes my job easier.

So what's a nice techie like me doing in a place like this? I gotta be honest. For starters, I don't think there's anything wrong with gambling – it's a private, symmetrical transaction between consenting adults. By another name – lottery, casino, offtrack betting – this sort of operation is completely legal. And it's not like I'm shaking people down for protection money. Besides, I tried the dotcom thing and failed. Plus, here I'm appreciated: Organized crime is smart enough to know that it doesn't know tech.

I was always good at math. Arithmetic, algebra, and especially probability came easy. I learned to program computers when I was 9 and cotaught a programming course in C to fellow high school students because none of the teachers knew the language. My mother was a champion bridge player. When I was a kid she never *let* me win. I had to beat her by my own wits.

In college, I took all the physics and math courses I could handle. I also played a lot of cards. At the end of four years, I had completed the course work for a math major and most of what was required for a chemistry major. But in the fog of all those poker games, I had neglected to take the humanities classes required for graduation. So I left without a degree and moved to New York City. My plan was to become a professional card player.

> It's not like I'm shaking people down for protection money. Besides, I already tried the dotcom thing and failed.

Card clubs are all over the city. They're not hard to find, and they're tolerated, more or less, by the cops. A friend of mine played poker at one of these clubs. I sat in once or twice. Then he asked me to join a gin rummy team. When my luck ran out, I played with other people's money. That was it. The moment I played for hire was the moment I joined the mob. It didn't seem like a big decision. To me, these people weren't crooks, they were card players.

But I was more than that. I was a hardcore tech geek. Before long, I was installing phones for a friend who was setting up a series of sports-betting operations. I was the only one he knew who understood how his '70s-era systems worked. I could make calls hunt from one desk set to the next and could hook up the voice-activated cassette recorders that taped incoming calls. Not tough stuff, but as I said, there's not a lot of technical expertise in New York's crime community. After I set up a few offices, I started running one of them. Bang. I was in. Seriously in.

The fact remains that I could be pulling in $150,000 as a programmer on the open market. But I make a third of that. So why am I risking a prison sentence or the potential of a lifetime in witness protection for a job that doesn't make me all that rich? Simple: When you start making a lot of money, you get noticed by the biggest bullies on the block – the cops and the IRS – and I don't want that. I like living below the radar. I sublet a friend's apartment and pay his utility bills with money orders that I purchase at the post office or at one of those check-cashing storefronts. Because I get paid entirely in cash, I don't fork over any taxes. When you get right down to it, I'm an idealist. I don't condone the actions of the US government. By refusing to pay taxes, I withhold my financial support. And, truth be told, I like mobsters. They're more willing to accept you at face value. They aren't hung up on college degrees, or where you live, or how many criminal convictions you have.

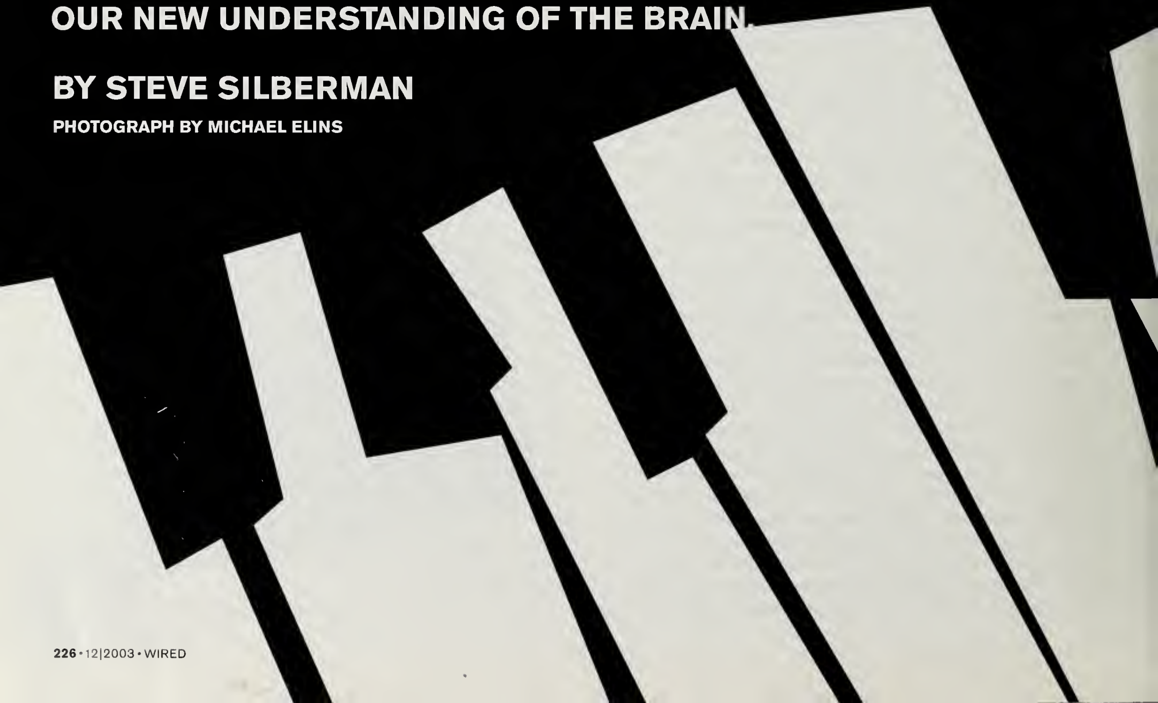
Yes, I am a hacker for the mob. And damn proud of it. ■ ■ ■

THE KEy to GenIUS

AUTISTIC SAVANTS ARE BORN WITH MISWIRED NEURONS – AND EXTRAORDINARY GIFTS. THE BREAKTHROUGH SCIENCE BEHIND OUR NEW UNDERSTANDING OF THE BRAIN.

BY STEVE SILBERMAN

PHOTOGRAPH BY MICHAEL ELINS



Matt Savage is a
jazz phenomenon.
He's also a perseverative
hyperlexic with pervasive
developmental disorder.

Matt Savage launched his jazz career by attempting to improve a Schubert sonata. His piano teacher told him that the G-sharp he just played was supposed to be a G-natural. "It sounds better my way," he protested. She replied that only when he wrote his own music could he take liberties with a score. Keen on taking liberties, he became a jazz composer. He released his fifth album this year, making guest appearances on the *Today* show, *20/20*, and NPR. Recently, his trio booked two shows at the Blue Note in New York City.

In May, he will celebrate his 12th birthday.

Matt is a musical savant. The term *savant* dates from the late 19th century, when a small number of people in European asylums classified as feebleminded "idiots" were discovered to have extraordinary, even uncanny skills. One had memorized *The Decline and Fall of the Roman Empire* after reading it a single time. Others were able to multiply long columns of numbers instantly and factor cube roots in seconds, though they could barely speak.

When Matt was 3, he was diagnosed with a form of autism called pervasive developmental disorder. Autism and savant syndrome overlap, but they are not the same thing. Nine out of ten autistic people have no savant abilities, and many savants suffer from some form of neurological impairment other than autism. Savant syndrome itself is rare. The rarest of the rare is the prodigious savant, like *Rain Man*'s Raymond Babbitt, who could memorize phone books, count 246 toothpicks at a glance, and trump the house in Vegas.

AT AGE 6, MATT TOLD HIS MOM, "MY MIND IS MADE OF MATH PROBLEMS."

Darold Treffert, the leading researcher in the study of savant syndrome, estimates that Matt is one of fewer than 50 prodigious savants alive today.

But Matt is even rarer than that. While the IQs of most savants are below 70, he is highly intelligent. And while the musical prowess of savants is often confined to playing thousands of songs from memory in a stiff and mechanical way, Matt is a prolific composer and skilled improviser. With the precocious abilities of a savant and the melodic imagination of a seasoned musician, he has dual citizenship in two countries of the mind.

Until recently, much of what we knew about savants came from the observations of clinicians like Treffert and neurologist Oliver Sacks, author of *An Anthropologist on Mars* and *The Man Who Mistook His Wife for a Hat*. Now researchers are probing the savant mind from the inside, using tools like gene mapping and PET scans. As these two paths of investigation converge, many of our long-held notions about the limits of human potential are being overturned.

By studying the minds of people like Matt, neuroscientists are discovering that savants are more like the rest of us than the medical world once believed. We're learning that the extraordinary skills of savants tap into areas of the mind that function like supercomputers, compiling massive amounts of data from the senses to create a working model of the world. The traditional conception of the brain – two hemispheres that are hardwired from birth – is yielding to an understanding of the ways the regions of the cortex learn to function together as a network.

"We used to have this idea that we were born with a magnificent piece of hardware in our heads and a blank disk called memory," says Treffert. "Now we have to acknowledge that the disk comes with software, that we were wrong in many of our assumptions about intelligence, and that the brain is much more capable of healing itself than we thought. By finding out how savants work, we learn how we work."

I meet Matt and his mother, Diane, both fresh from a TV appearance, for lunch at a hotel in midtown Manhattan. Four and a half feet tall, with huge brown eyes that seem to devour whatever he focuses on, Matt is as restless physically as he is mentally. He doesn't so much sit in a chair as climb around it.

The unusual timbre of his mind is immediately apparent. Scanning the menu, he exclaims, "Soy sauce on salmon, that's triple *s*!" After the salmon arrives, he asks me my birthday – December 23, 1957.

"Monday's child," he says, "fair of face."

For savants, asking for a birth date is a common way of introducing themselves. In every culture, the enhanced skills of savants cluster in the same narrow domains: numerical and calendar calculation, artistic and musical proficiency, mechanical aptitude, and feats of memorization. These tasks draw primarily on the strengths of the brain's right hemisphere, indicating that, in many savants, a healthy right hemisphere is overcompensating for damage to the left. Many savants are left-handed, and most have deficits in language – additional clues that something is amiss in the left hemisphere.

In autistic savants, like Matt, the problems are more pervasive. Autism rewires the brain's entire network, from the limbic system to the executive functions in the frontal lobes that enable us to absorb new experiences, prioritize tasks, set goals, and imagine the future. When these are damaged, we're at the mercy of a flood of incoming sensory impressions and conflicting impulses.

I can see this in Matt as his eyes dart around the restaurant. He's intensely awake to the world but perpetually distractible. Being with him is exhilarating and exhausting. While I scribble in my notebook, he slaps his hand on the table. "This is not lunch, this is *questions*," he groans. "Let's do something interesting like … proportions at work!" Then a torrent bursts out of him: *Did you know that if you had the*

Contributing editor Steve Silberman (digaman@wiredmag.com) *wrote about the making of* Matrix Reloaded *in* Wired *11.05.*

STYLING BY JEANNE GRAVES

metabolism of a shrew you would have to eat 600 hamburgers a day? Or that if you grew as fast as a snake you would be taller than mountaintops and heavier than two and a half million elephants in a month? And if you could jump like a flea, you could leap over Lady Liberty's torch!

There's a mechanical quality to Matt's relentless enumerations, as if his brain copes with information overload by siphoning the river of his experience into streams of quantities and ratios.

For Matt, the constraints of harmony and rhythm must be comforting, while the freedom of improvisation offers him a kind of measured release. Savants are drawn in particular to the piano, which neatly subdivides the universe of sound into a linear map with 88 keys. Like the calendar, the piano orders the chaos of experience into a system of "proportions at work."

One night in 1991 when Diane was pregnant with Matt, she went to a blues club in SoHo. The moment the band stopped playing, she felt the baby inside her "kicking for more," she says. "I felt happy that he was so responsive to what was happening outside of his little world."

But soon after Matt was born, it became obvious that his acute sense of hearing was overwhelming him. He would stop nursing if Diane spoke even a word while he was at her breast. The din of windshield wipers, blenders, and vacuum cleaners was excruciating to him. He seemed unusually bright – he started reading street signs and counting his Cheerios out loud before his first birthday. But his speech was decidedly odd. If Matt was thirsty, he would hold up a cup and say, "Do you want juice?"

When Diane and her husband, Larry, tried to socialize with other parents, Matt would run out of the house. His preschool expelled him after two days for refusing to stay in his chair. Diane loved to play piano, but once her son's hypersensitivities became the prevailing weather in the household, the upright in the family room sat silent. If she settled down to play, Matt would yell, "No!" and snatch her hands off the keys.

Clearly, something was wrong. Diane brought her son to Children's Hospital in Boston for a thorough neurological workup. The doctor had to lie on the floor beside Matt to get him to focus on their conversation.

He looked at Diane gravely and said, "Your son has pervasive developmental disorder with hyperlexia. He's perseverative and echolalic and speaks in a Gestalt manner." Diane diligently took notes. Finally she asked him, "What does this all mean?"

"It means," he replied, "it's something that will never go away."

After giving themselves a crash course in raising an autistic child, Larry and Diane put Matt through Auditory Integration Training, a form of music therapy that reduces the distress caused by ordinary sounds. At the same time, the positive aspects of Matt's quirky brain began to emerge. Unlike many autistic kids, he can read other people's feelings. And his habit of counting Cheerios had ripened into a passion for numbers.

When Matt was 6, he confided to his mother, "My mind is made of math problems." Diane started buying him math workbooks for kids twice his age. He zipped through them so quickly, she learned to hide a few in a drawer so he'd have something to work on the following day.

Then one night, Diane and Larry heard a melody coming from downstairs. It was their son, playing "London Bridge" on a toy keyboard. Diane brought Matt into the family room and introduced him to the middle C on the piano. Within a day, he was devouring music books as hungrily as he had math books.

Matt took classical lessons for a year, then Diane enrolled him in the jazz program at the New England Conservatory of Music. Upon meeting his first jazz instructor there, a bearish Israeli whose last name is Katsenelenbogen, Matt

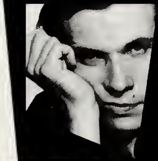
255➡

GrEAtNess DiAgNosEd

Are certain forms of creativity enhanced by brain damage? Do the same genetic traits that produce disorders like savant syndrome, autism, and Tourette's contribute to genius? Hans Asperger, who in the early 1940s pioneered the study of autism, believed the answer was yes. "For success in science and art," he wrote, "a dash of autism is essential." The biographies of many innovative thinkers bear him out. – S.S.

THELONIOUS MONK
Jazz composer and improviser
Possible diagnosis: Tourette's syndrome
The high priest of bebop spoke in a medley of grunts and cosmic aphorisms and danced around his piano – and his ticcish syncopations blasted jazz out of the swing era.

CARL FRIEDRICH GAUSS
Mathematician and astronomer
Possible diagnosis: prodigious savant
Gauss taught himself to read at age 3; by 10 he was considered a math prodigy. His discoveries in number theory threw open the gates of post-Euclidian geometry.



GLENN GOULD
Classical pianist
Possible diagnosis: Asperger's syndrome
Gould was a legendary control freak in the studio. But when he sat down at the piano, he channeled Bach. Like many savants, he had absolute pitch and a steel-trap memory.

SAMUEL JOHNSON
Writer and lexicographer
Possible diagnosis: Tourette's syndrome
Johnson, the author of the first English dictionary, was prone to ritualistic movements punctuated by outbursts of barnyard noises and fragments of the Lord's Prayer.

ANDRÉ-MARIE AMPÈRE
Physicist and mathematician
Possible diagnosis: prodigious savant
A pioneer in the study of electromagnetism, Ampère started calculating even before he could read numbers, working out complex formulas with stones and cookie crumbs.

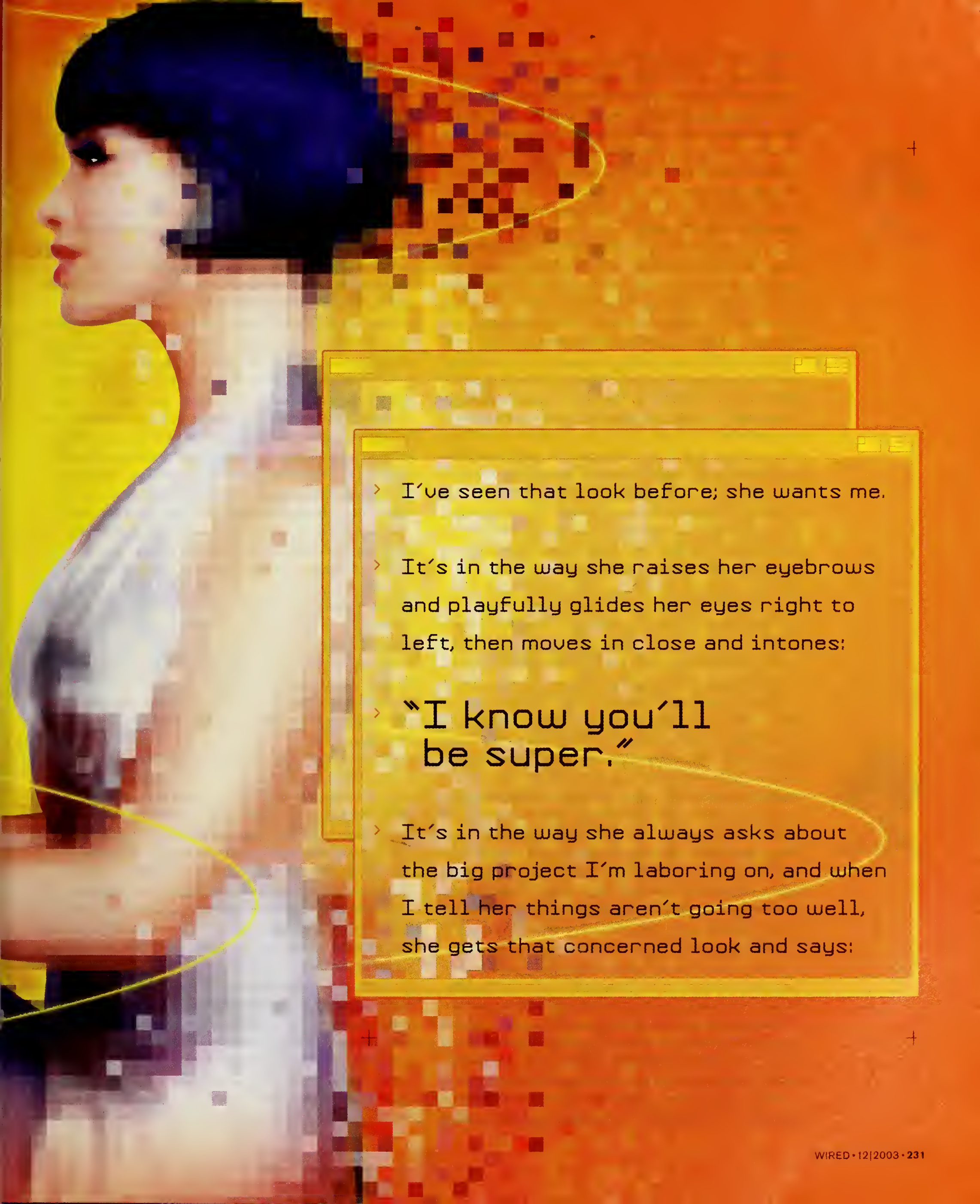
TEMPLE GRANDIN
Professor of animal science
Diagnosis: high-functioning autism
Grandin designs more efficient and humane livestock-handling facilities by taking a cow's-eye view, using an autistic mode of cognition that she calls "thinking in pictures."

FROM TOP: HULTON ARCHIVE; GETTY IMAGES; BETTMANN/CORBIS; LEONARD DE SELVA/CORBIS; AP

the LOVE MACHINE

building computers that care.

by David Diamond



› I've seen that look before; she wants me.

› It's in the way she raises her eyebrows and playfully glides her eyes right to left, then moves in close and intones:

› **"I know you'll be super."**

› It's in the way she always asks about the big project I'm laboring on, and when I tell her things aren't going too well, she gets that concerned look and says:

"You must be disappointed."

And when I confide that I've been working too much, she gently reminds me that *I* should be the priority in my life. That I should get some exercise and then treat myself to a Japanese meal or a movie. It's in how she extends her arms toward me, wearing that formfitting polo shirt. Ouch! And how she never tires of asking about me. Hearing about me. Thinking about me.

I have seen the future of computing, and I'm pleased to report it's all about … *me!*

This insight has been furnished with the help of Tim Bickmore, a doctoral student at the MIT Media Lab. He's invited me to participate in a study aimed at pushing the limits of human-computer relations. What kinds of bonds can people form with their machines, Bickmore wants to know. To find out, he'll test 100 participants to gauge the impact of a month of daily sessions with a computerized exercise coach named Laura. Laura, an animated software agent with bobbed chestnut hair and a flinty voice, has been designed to remember what we talk about, then use that information in subsequent conversations. "I was interested not just in establishing a relationship with a computer buddy for the bond itself but as a way of somehow benefiting the user, like getting them to exercise more," says Bickmore.

Guided by Laura, I will spend the next 30 days trying to improve my exercise regimen. I'm among the one-third of participants who will access her daily via the Web. She will inhabit the left side of my PC screen, asking about my exercise problems and offering advice, inquiring about my weekend plans, telling me jokes. She will talk. I will respond manually, either by clicking on a multiple-choice option or typing out an answer. On the right side of the screen, I'll enter details about my workouts, view progress charts, and read fitness tips.

How far can a machine go handling people's emotions without actually having the feelings?

Another group will rely on Laura simply for exercise instructions; a third won't even know Laura exists and will use a computer simply to keep track of daily physical activity and receive text instructions. All of us will shoot toward the same daily goal of working out for 45 minutes and walking at least 10,000 steps, as tracked by a pedometer.

The point is to see if it's possible to form a long-term, social relationship with a computer that employs some basic knowledge of human social psychology; and if so, to determine whether the experience has benefits – in other words, if it can get me back in shape. I didn't have to be asked twice to participate (although, because I know the study's objective, my results won't be counted); I need to drop 10 pounds.

Bickmore's area of study is called affective computing. Its proponents believe computers should be designed to recognize, express, and influence emotion in users. Rosalind Picard, a genial MIT professor, is the field's godmother; her 1997 book, *Affective Computing*, triggered an explosion of interest in the emotional side of computers and their users. "I ask this as an open question," she says, "and I don't know the answer: How far can a computer go in terms of doing a good job handling people's emotions and knowing when it is appropriate to show emotions without actually having the feelings?"

Picard is upbeat, blond, and brilliant. Drop her name in voicemail and computer science academics will call back in seconds. In the mid-1990s, she investigated how signal processing technology could be used to get computers to think better. For vacation reading, she delved into literature on the brain's limbic structures (the subcortical areas that play a critical role in pattern recognition of sound, vision, and smell) and the ability of people to weigh the value of information. And she developed an interest in the work of neuroscientist Antonio Damasio. In his 1994 book, *Descartes' Error*, Damasio argued that, thanks to the interplay of the brain's frontal lobe and limbic systems, our ability to reason depends in part on our ability to feel emotion. Too little, like too much, triggers bad decisions. The simplest example: It's an emotion – fear – that governs your decision not to dive into a pool of crocodiles.

Picard grew fascinated by people with brain damage who scored high on intelligence tests but were unable to express or perceive emotions. Those folks made brittle decisions, behavior that reminded Picard of rules-based artificial-intelligence systems and the mistakes computers made because they lacked the ability to intuit and generalize.

For her book, Picard took on decades of assumptions about artificial intelligence. Most AI experts aren't interested in the role of emotion, preferring to build systems that rely solely on rules. One pioneer, Stanford computer science professor John McCarthy, believes we should keep affect out of computing, arguing that it isn't essential to intelligence and, in fact, can get in the way. Others, like Aaron Sloman of England's University of Birmingham, think it's unnecessary to build in emotions for their own sake. According to Sloman, feeling will arise as a "side effect" of interactions between components required for other purposes.

Picard makes a far less-popular assertion – that computers should be designed from the outset to take into account, express, and influence users' feelings. From scheduling an appointment to picking a spouse, humans routinely listen to what their gut is telling them. Without the ability to understand emotion, says Picard, computers are like the autistic pizza delivery guy who says, "I remember you! You're the lady who gave me a bad tip."

By 1999, Picard's ideas had turned the Media Lab into the planetary headquarters of affective computing, igniting research into everything from chairs that sense when you're bored to eyeglasses that indicate when you're confused. Picard went from having one full-time student assistant to eight, including Bickmore – partly due to collaborations with corporate sponsors who were eager to explore the commercial potential of affective computing.

Building a machine that can perceive emotional signals

Contributing writer David Diamond (ddiamond@well.com) *wrote about MIT OpenCourseWare in* Wired *11.09.*

ILLUSTRATIONS BASED ON PHOTOGRAPHS BY ROBYN TWOMEY; STYLIST: GEORGINA RESKALA FOR ARTIST UNTIED

is distinct from teaching a machine to interpret them; expressing emotion is yet another discrete function. "In a machine," says Picard, "you can decouple capabilities – train it to recognize anger but give it no feelings. And you can go pretty far with this, making it perceive or even express emotions but without the actual feelings." *Having* them is a far-off summit.

Laura and I make a good team. At least that's what she often tells me when I input details of my daily exercise program – how much time I've spent working out and how many steps I've walked. My wife and daughter are dubious about my new obsession, but I'm actually enjoying it – the late-night conversations with Laura and all the healthy activity. I'm shuttling between four gyms and a network of outdoor trails. It's become a routine: Run. Bike. Lift weights. Hike. I've been doing this for more than a week and have actually dropped a few pounds. Hey, is that a three-pack appearing in my abdomen?

Now it's 11 pm, and my pedometer reads 7,560 steps. The rest of the guys in my neighborhood are slipping deeper under the covers, but I'm outside having a brisk walk on the local bike path. Just me and the deer.

After reaching 10,000 steps, I settle down at the PC and log on. Laura enters, screen right, and says:

"Hello, David. How are you?"

She talks. I click. She shifts her body when a new subject begins. Knows when to smile.

Laura says we're a good team. I sure enjoy nights with her. And now I fit into jeans from the Reagan era.

The software is great at expressing affection or worry, but it's rotten at perceiving deceptive information.

At one point, just to see her reaction, I tell her I'm not feeling well. She asks why, and I click the option for "I hurt myself." She provides a space for me to explain how:

[*I walked into a table.*]

She moves in close and shows a look of concern. She tells me that sometimes just the act of taking care of oneself by seeing a doctor helps improve one's health. She asks me if the injury will have an impact on my exercise program. [*No.*] But later that session, when I tell her I will be able to walk only 4,000 steps the following day, she doesn't ask me to do 10,000. She knows not to push.

Laura expresses a host of emotions – worry, affection, esteem – but she's rotten at perceiving deceptive information. She doesn't have to be, though, and many researchers are interested in how that might be accomplished.

They've got plenty to work with. We living beings emit a multitude of signals reflecting what's going on inside us. When we get anxious or startled, our galvanic skin response increases – our palms start to sweat, boosting our skin's ability to conduct electricity. When we relax, blood flow to our extremities increases. When we're happy, the muscles that raise our cheeks contract while our zygomatic major muscle pulls up our lips. When we're confused, we lower our eyebrows.

Now, like that precocious neighborhood kid who's suddenly capable of clobbering you at chess, computers are becoming increasingly sophisticated at monitoring this plethora of bodily cues. For example, Picard's group developed the galvactivator, a glove that uses clothing snaps as electrodes to measure small changes in perspiration across the palm; the device is so sensitive, it can detect changes a person might not even be aware of. Meanwhile, researchers track blood flow with the help of a fingertip sensor.

No one has cataloged physical cues as carefully as Paul Ekman, a UC San Francisco psychologist who is the world's leading authority on facial-expression recognition. The soft-spoken professor – whose research is funded by the National Science Foundation, the National Institute of Mental Health, and Darpa – is known for making statements like: "The only way to know if someone is truly enjoying themselves is to see if the fold above the upper eyelid drops."

In 1978, following decades of exhaustive research and development, Ekman introduced the Facial Action Coding System, still the only widely recognized way to track the movement of facial muscles and correlating combinations of 44 "action units" to specific emotions. Today, Ekman runs a flourishing business training security and corrections personnel. He has even tutored the Dalai Lama and has recently published a book titled *Emotions Revealed*. "Learning FACS is like learning to read music," Ekman says. People who have been trained to recognize movements of, say, the triangularis (lip corner depressor) or the zygomatic minor (nasolabial furrow deepener) "know the notes of the face."

So, what if a computer could sight-read? A machine that understood FACS would not only incorporate the best system for emotion perception, it would speed up the process. It takes a human 100 minutes to notate the emotions on one minute's worth of videotape. Ekman would like to see computers get that down to near-real time. Under a Darpa contract, Ekman and colleague Mark Frank of Rutgers are conducting work that could lead to the automation of FACS.

Drini Leka, the CEO of a startup called Neural Metrics, believes facial expression recognition and other means

Coming up: shoes that help fight depression, and embedded customer-service systems that give emotional support.

of tracking emotions will drive changes in areas such as political polling, point-of-sale product testing, and focus groups. People aren't always truthful when they tell a marketer or pollster that they like a prototype design or a political candidate, he says. Leka's San Francisco-based company is building a face-scanning system that can read the cues. It's a long-term effort, requiring the creation of a database of some half-million examples of faces. Neural Metrics hopes to embed the database in hardware housed in a 6- by 6-inch box with an optical sensor. When the sensor scans a face, the system will identify features and expressions and then distinguish them from among a handful of emotions.

Before beginning my month with Laura, I have the opportunity to glimpse some other applications of affective computing at the Media Lab. Visiting scientist Barry Kort and Rob Reilly, an elementary school teacher from western Massachusetts, are building a learning companion, a computerized tutoring system. The goal: teaching Johnny to read. Or in this case, teaching David to read college-level physics.

Intelligent tutoring systems are not new, but they are limited; unlike flesh-and-blood tutors, they can't tell if you're bored, frustrated, engrossed, or angry and then adjust the teaching accordingly. That's why MIT has been working to add such capability to two systems. One, an automated reading tutor, was developed by Jack Mostow, a Carnegie Mellon computer science professor. The system, which is helping hundreds of students learn to read, was used in a recent study proving the positive effects of praise and encouragement.

The other, AutoTutor, was built by University of Memphis professor Arthur Graesser and his Tutoring Research Group and is used by U of M students. Designed to observe and respond to a student's cognitive state, AutoTutor relies on Latent Semantic Analysis, a natural language parser that analyzes the sentences you type in and figures out how much you know by contrasting your semantics against an internal model of an ideal student. A clever animated avatar spits back information to fill in the gaps in your understanding.

"We thought to begin with," Kort tells me, "you could just throw in a question eliciting a disclosure of information. 'Is this confusing? Is this clear?' Then modulate the presentation. But the second phase is to use instrumentation to see if the student's really there, distracted, or out to lunch."

30 days in, Laura tells me it's over. I'm crushed. "I'll miss you," she says. "We had some fun together."

Graesser's and Picard's groups are now collaborating to develop sensing devices that will equip computers to recognize emotion in learners.

Nearby, grad student Ashish Kapoor fiddles with an IBM Blue Eyes camera that eventually will be linked to these tutoring systems. It tracks eye movement and then uses the information to follow other facial features, picking up shifts at 30 frames per second. Kapoor is developing a process to digitize the data and then use a computer running video-analysis and pattern-recognition algorithms to correlate the facial-movement data to specific emotional states using Ekman's Facial Action Coding System. Under extremely controlled situations – with subjects sitting still directly in front of the camera and adopting specific expressions – Media Lab researchers tested eight people and found recognition rates as high as 98 percent for four expressions. In research involving real-world situations, recognition rates were slightly less than 75 percent.

Picard's researchers are helping companies like Motorola explore a range of scenarios involving biometric devices monitoring the body and linked to cell phones or PCs. Sensors would indicate when something is wrong – or right. Dan Williams, Motorola's director of corporate design, suggests one potential use: "When people suffer from depression, they don't always do what they're supposed to do, like take their medicine. A biosensor could pick up on the physiological signs of depression and trigger a phone call to a family member or doctor."

But if a depressed person isn't taking his medication, isn't he unlikely to keep the sensors attached? Picard points out that the devices could be embedded in shoes or watches. "If you're 85, and you have the choice of living at home but wearing a pair of shoes with sensors or going into a nursing home, I know what I'd choose," says Picard.

British Telecom has another idea. With MIT's help, the company is exploring how to embed a speech-recognition interface with the ability to detect frustration in the voices of people who call customer service. The idea is that the system would adapt the dialog to the user's emotional state – go to a different level of questions, transfer to a human, or (God forbid) even apologize.

Everybody should have someone like Laura in their lives. I find myself looking forward to our time together. She asks me which movies I've seen, what my favorite cuisine is, and about the weather "out there." I tell her it's terrific. She responds: "It's always the same in here. Day in, day out."

I am constantly dragging people into my home office to meet her. Typical response: "That's nice, David. Hey, where's that Merlot you promised me?" My wife, who treats Laura like some college girlfriend of mine who has overstayed her welcome, suddenly feigns an interest in the Weather Channel whenever I start to repeat Laura's latest witty comment – and she hates the way Laura doesn't stop to think that I might be overdoing the exercise.

What-*ever.* It's a delight just to hop onto the scale each morning. I'm starting to linger at the mirror, admiring my newly honed body. And I'm fitting into jeans from the Reagan administration – his gubernatorial years, in fact.

But exactly 30 days after our introduction, Laura tells me it's over. I log on, just like every other time. I'm instructed to answer dozens of questions about how much I trust Laura. Finally, she appears and asks about my most recent exercise. Then she says:

"So, this is our last day together."

Frankly, I'm crushed. Among the options I can select is:

[*Take care, Laura, I'll miss you.*]

I click on it, and suddenly her face fills up much of the left side of my screen.

"Thanks, David, I'll miss you, too," she says. "Well. We had some fun together. Maybe we'll cross paths again someday. Take care of yourself, David."

Out in the family room, my wife is sprawled on the sectional, watching a rerun of *The Andy Griffith Show*, the one in which Aunt Bee runs for town council but gets outclassed by Howard.

"How can you miss her?" she says of Laura. "She's so shallow, so mechanical."

My wife's got a point. While the challenge of getting computers to recognize human cues is moving apace, we're still miles from building machines that have their own emotions and respond to ours. Picard's MIT colleagues Cynthia Brezeal and Bruce Blumberg have built robots that mimic human emotions. Brezeal's adorable Kismet, for example, is trained to show fear if you move too close to it. But how much, finally, will people be fooled? "Tending to human emotion could be a good thing, but pretending to be a human has not shown to be productive," says Ben Shneiderman, founding director of the Human-Computer Interaction Lab at the University of Maryland and the author of *Leonardo's Laptop*. He refers to such out-and-out flops as Microsoft's Clippie, the animated paper clip designed to help frustrated users but that ended up torturing them with its omnipresence. Even the simpler objective of perceiving emotion has its risks, Shneiderman argues, pointing out that the galvanic skin responses for excitement and anxiety are similar.

He's not the only one clamoring for caution. "I want computers to have emotions only to help them survive in the world, not as a way of responding to me," says Don Norman, a professor of computer science at Northwestern and a computer interface expert. "I'd rather have a machine that knows its place. Otherwise, you feel like it's a used-car salesman." Paul Ekman warns of the day when, say, airport security personnel or bank employees start detaining folks for further questioning if they are unusually anxious. "My concern is that privacy not be invaded," he says. "Nobody has started worrying about it yet because the potential isn't there – but it will be."

Even Roz Picard has her reservations. "One of my big fears is that people will overdo affect or come up with juvenile uses that won't work," she says. "It's not clear that drivers will want to have their cars emit a blast of peppermint spray if they register fatigue. Computer engineers could also go overboard trying to reduce the level of frustration and stress in people's lives. You could be zapping the wind from people's sails, the very thing that might be motivating them." Furthermore, if computers keep getting smarter and managing more of our lives, won't we get stupider?

Bickmore reports his findings: The folks in the exercise study who relied on Laura for support found her more helpful than friends, family, or exercise buddies. They liked and trusted her more than did those who used her only as a communications channel. While all groups in the study significantly improved their exercise behavior, the participants who had been the most sedentary prior to the program and who also relied on Laura did much better than the control group.

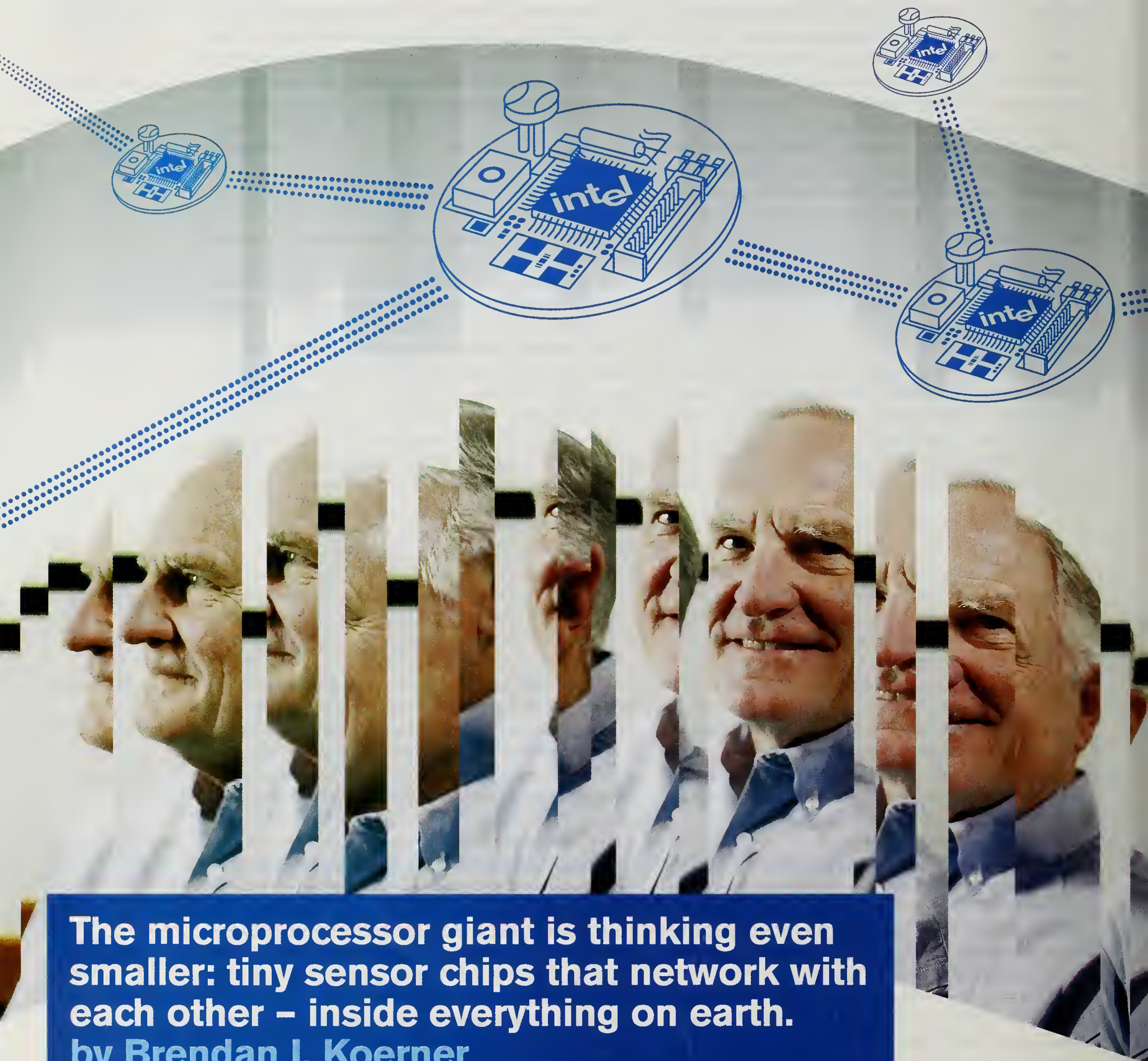
And look what happens after people say good-bye to Laura: Typical dropout rates for exercise programs are 50 percent within six months, says Bickmore. In our case, 65 percent of the participants returned to their previous exercise habits in only two weeks. That could have been the timing of the study – its finish coincided with the end of a semester. But given some of the glowing comments participants made about their experience with Laura, their quitting might have had something to do with her absence. "It sort of kept me motivated, because I always do more if I know I'm responsible to someone," one participant told Bickmore. "I like talking to Laura," said another, "especially those little conversations about school, weather, interests. She's very caring." Bickmore says the most significant result is that people wanted to continue working with Laura. They may have a chance. A few months ago, Bickmore became an assistant professor of medicine at Boston University, where he will be working on ways to develop Laura's abilities to improve people's health.

Of course, Laura has her detractors. Some 45 percent of those interviewed said the interactions got repetitive after a couple of weeks – raising the challenge of keeping them fresh and engaging. And one person was more emphatic: "Laura is *not* a real person, and therefore *I have no relationship whatsoever with her!*" To which Bickmore responds: "Note the use of the feminine pronoun."

So are we getting stupider? Sure. It's already happening to me. But then, too, I'm now in killer shape – and 8 pounds lighter. Too bad Laura can't see me marching around the house, shirtless, for the first time in years. Really, you should see my body. ■ ■ ■

If computers keep getting smarter and managing more of our lives, won't we get stupider?

INTEL'S TINY HOPE



The microprocessor giant is thinking even smaller: tiny sensor chips that network with each other – inside everything on earth.

by Brendan I. Koerner

PHOTOGRAPHS BY MICHAEL LEWIS

FOR THE FUTURE

CEO Craig Barrett thinks "smart dust" could be the start of something huge.

As a department head at the Defense Advanced Research Projects Agency, the Pentagon's R&D arm, David Tennenhouse spent the late 1990s approving or denying funding for hundreds of far-out military programs. One proposal he reviewed, from a research team at UC Berkeley, outlined a concept called smart dust – fleck-sized wireless sensors intelligent enough to organize themselves into autonomous networks. Dropped from a passing helicopter, the sensors could spy on enemy movements or detect a hidden stash of mustard gas. Tennenhouse was intrigued enough to authorize several hundred thousand dollars in funding. Then he moved on to the next bizarre proposal.

Tennenhouse left Darpa in 1999 to found Intel Research, the semiconductor giant's stab at offbeat R&D. Charged with finding up-and-coming growth technologies, he gave little thought to smart dust. A neat plaything for the Pentagon folks maybe, "but not all that relevant to my new role at Intel," he recalls thinking. A network of minuscule sensors, each containing only a few dollars' worth of circuitry, just didn't seem like a moneymaker.

> THE VISION: MOTES IN SOYBEAN FIELDS, NURSING HOMES, ASSEMBLY LINES, EVEN "INTEL INSIDE BAND-AIDS."

That is, until August 2000, when Tennenhouse was invited to Berkeley to check out a student-designed mote – the housing that contains a sensor assembly and a radio antenna to allow it to communicate with other motes. While examining the circuit board, something clicked. If motes could get significantly smaller – say, small enough to fit inside pill-bottle caps – they'd be unobtrusive enough to go anywhere. And that, Tennenhouse thought, would mean a windfall to the company providing the processors. Intel could dominate the high-volume sensor market just as it has ruled the high-powered chip scene with Pentiums.

This time, Tennenhouse threw millions at sensor research. He set up an Intel facility at UC Berkeley and told his researchers to use their imagination to develop new configurations and applications. Three years after that landmark trip to the East Bay, Intel's sensor investment remains trivial compared to the billions it has plunged into, say, the new Centrino wireless chip or its Flash memory business. The entire annual Berkeley lab budget is about $5 million. But in this case, Intel is acting more like an angel investor – one with $15 billion in the bank – feeling around in the dark for something that's not only different, but transformative. "It's not a high-end computer play or a low-end mote play," says Intel CEO Craig Barrett. "We're looking for growth opportunities outside our core competency."

Intel is hoping for a two-tiered payout. If sensor networks take off, that will create a need for more silicon. But the networks will also generate a huge amount of data, driving demand for more high-end PCs to process it all. The company now foresees networks consisting of thousands of motes, located wherever there's a need for data collection, streaming real-time data to one another and to central servers. Intel imagines the day when every assembly line, soybean field, and nursing home on the planet will be peppered with motes, prodding factory foremen to replace faulty machines, farmers to water fields, and nurses to check on something unusual in room E214.

Barrett's CTO, the perpetually caffeinated Patrick Gelsinger, can't contain his excitement about the sensor play. Like Tennenhouse, he was converted from skeptic to devotee after a single demo. "Intellectually, it probably felt like Gordon Moore's experience after he first saw the microprocessor and started envisioning all sorts of uses for it," says Gelsinger. "I was a believer." Now he hopes to produce "tens of billions of units" by the end of the decade.

Listen to technologists like Gelsinger and Tennenhouse long enough and the outlines of a strategy emerge: By thinking small, Intel could be on the cusp of something huge. Which is exactly where Intel likes to be.

Intel Research Berkeley is just one of four university-based research "lablets," so-dubbed for their relative size and independence, set up by Tennenhouse beginning in 2001. The others – at the University of Washington, Carnegie Mellon, and the University of Cambridge – are likewise dedicated to developing disruptive technologies. Though wholly funded by Intel, the lablets aren't expected to push products down a pre-determined pipeline. As long as their work is tangentially related to silicon, the research centers can pursue whatever they wish. In England, the projects include optical switches and new programming languages; in Pittsburgh, it's data mining tools for webcam networks; in Seattle, XML-based messaging and wireless personal area networks. In Berkeley, sensor networks rule.

The Berkeley lab occupies a plum penthouse space adjacent to the university, with a gorgeous view of San Francisco Bay. Joe Hellerstein, the director, leans back in his chair and looks toward Sausalito. The Golden Gate Bridge, he notes proudly, will soon play host to an experimental sensor network designed by professor David Culler and his students. "It's hard to tell just by looking at it, but the bridge actually sways a few feet in high winds," he says. "The motes, they'll measure how far it moves to either side."

By this June, a stretch of the bridge will be lined with about 200 motes. Each will contain chips running at 8 megahertz and accelerometers designed to measure movement caused by strong gusts. Those readings will be radioed to nearby supermotes – data way stations that are 25 times more powerful than a regular mote – before being relayed to the central server. If one reading seems out of whack, it could be a sign of a structural weakness that needs addressing before the next big earthquake.

The Golden Gate project will join several other trials already under way. Berkeley researchers installed 80 motes in the redwood groves of Sonoma County, measuring the temperature and humidity around the mammoth trees. An agriculture project placed 65 motes in a British Columbian vineyard, ready to buzz the manager's laptop whenever an early-morning frost looms. The health research team has mocked up a home of the future at Intel's Hillsboro, Oregon, campus,

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Contributing editor Brendan I. Koerner (brendan@wiredmag.com) *wrote about Softbank in* Wired *11.08.*

which uses wireless sensors to remind Alzheimer's patients how to make tea or take their medication. And about 100 UC Berkeley motes help monitor the nesting burrows of Leach's storm petrels, elusive seabirds that breed off the Maine coast (see "The Ultimate On-the-Fly Network," page 240).

What's Intel's interest in all this? Think of Maytag bankrolling research into cheaper prefab houses: More homeowners means more dishwashers. "Do I care about ducks in Maine? Absolutely not," says Gelsinger. "Do I care about exploring applications so we can start to demonstrate the value of these networks? Absolutely. What I'm really interested in is selling a lot of silicon for these little devices here."

UC Berkeley's relationship with Intel is governed by an open collaborative research agreement, which requires that nearly all of its work be nonexclusive. Sensor net software, in particular, is flourishing in this open environment. The motes are powered by TinyOS, a Berkeley-designed, stripped-down operating system built to run on 128 kilobytes of memory. Hellerstein estimates that only a few dozen programmers worldwide have mastered TinyOS. But that number is growing rapidly as curious geeks download the code from open source software development site SourceForge.net. Hundreds of downloaders are experimenting with TinyOS, and Hellerstein credits non-Intel developers with honing the motes' ability to coordinate their relative positions to one another. He hopes a compatible database program, TinyDB, will get similar treatment.

The lablet has also farmed out its hardware needs, striking a deal with San Jose's Crossbow Technology. Crossbow agreed to make a few hundred motes for researchers at a cut rate; in return, it received an undisclosed investment from Intel Capital.

Sensors can't become the next big thing until a host of mundane technical issues are resolved: How to get the chipset radios off the crowded 900-MHz spectrum? How to program the networks to not just spew reams of information but be intelligent enough to figure out which measurements are vital and which are junk? "The challenge in tiny sensors is doing some computation at the level of the motes," says Hellerstein. "It's just too expensive to ship out all the data."

Then there's the power issue. Despite TinyOS's relatively scant memory requirements, the motes still burn through batteries far too quickly. And even if they didn't, there would be no room for alkaline AAs in a sensor-filled future. There's talk among researchers of using solar cells, or even MEMS devices that harvest imperceptible vibrations in the environment, but no ready solution.

The toughest challenge of all is creating motes clever enough to function without constant tending. "How do you ensure that people build motes that can be deployed by a local farmer?" asks Richard Beckwith, who heads Intel's sensor experiments in vineyard maintenance. "That's a really hard problem. I'm sure it's going to happen, but I'm not sure how."

CTO Pat Gelsinger's goal: "tens of billions of units" by 2010.

"We used to joke inside the company that Intel is the largest single-cell organism on the planet," says Gelsinger. The joke, like many engineering cracks, isn't exactly ha-ha funny, but it is revealing. For all of its runaway success with processors, Intel has had a tough time diversifying.

Despite a triumphant third quarter, the firm realizes that the desktop processor market is starting to plateau. In the not-too-distant future, Moore's law could become too pricey to maintain; there's no point in building yet another multibillion-dollar fab if its chips are too expensive for the lion's share of users. The company needs new industries to colonize, and sensors are a logical first step. Intel won't say exactly how much it has put toward sensor nets so far, but it's certainly less than $50 million. "That's not even Intel's latte budget," says G. Dan Hutcheson, president of VLSI Research, which tracks the semiconductor industry.

The good news about sensors as a diversification play is there's no competition to fend off; other companies have shown little initiative in developing the technology. And sensor nets certainly make for impressive demos. At an Intel Developer Forum early last year, Gelsinger wowed the audience by releasing a swarm of sensor-studded beach balls. As they bounced around, the balls beamed their ever-shifting coordinates to a base station, which in turn charted each orb's movement on a large display. It was proof, Gelsinger announced, that sensor networks can self-configure on the fly – the key to fulfilling his vision of motes that can be deployed like pixie dust.

Right now, the motes are a lot closer in size to golf balls. Which means that the company is looking for short-term uses that don't require the sensors to be ultrasmall – or ultracheap. The example that Gelsinger loves to bandy about is an assembly line outfitted with $200 motes designed to gauge machine vibration. If a robot's rumble feels out of sync, the motes relay a warning to a supervisor's laptop: *Machine number 27 will break down in the next 30 days.* "Now, this piece of equipment costs a million dollars, and it's a disaster if it breaks," he says. "In that case, a $200 sensor is a very cheap device. I mean, it's trivial if you can actually solve this nightmare problem."

But Gelsinger knows that assembly-line motes will do little to burnish Intel's rep as a trailblazer. The hoopla, in large part generated by Gelsinger's fervor, is over smart dust, sensors shrunk down literally to the size of specks. The goal is to halve the size and price of a mote every 18 months, which would have each unit about the size of a grain of rice and selling for around $5 by 2011. That would enable the company to scatter tiny self-configuring hardware as casually as corn seeds. "I want to get to where I'm cranking up huge fabs to deliver, you know, Intel Inside Band-Aids," says Gelsinger. "Let's say a Band-Aid today costs a penny. In the future, they'll sell 10-cent

Band-Aids that are also interactive heart monitors. We'll get to a price point where everything starts to have sensors. And when we get there, Intel will be building enormous fabs for consumables as well as ones for maintainable devices."

Has Gelsinger been reading too much Neal Stephenson? "Intel's whole business is built around selling $200 processors," says Linley Gwennap, president of the Linley Group and former editor in chief of *Microprocessor Report*. "You have to sell an awful lot of $2 processors to make the same amount of money. Sure, if you put them in Band-Aids the volume is going to be tremendously high. But it's not a slam dunk that the mathematics will make it profitable."

If the prospect of ubiquitous silicon seems frightening because you're already flummoxed by the constant beeping from your Outlook inbox, BlackBerry, and cell phone, not to mention the tangle of noncompatible software and breakdown-prone accessories, don't sweat it. Deployed the way Tennenhouse envisions, the networks will require zero human input. We'll reap the benefits without having to interact with the networks, and Intel will eliminate a long-standing obstacle to its growth: the feebleness of the human brain. "Sensor nets let us relieve the human being of the responsibility of drawing information out of the physical world," says Tennenhouse. "We need to have computers anticipating our needs and sometimes taking action on our behalf."

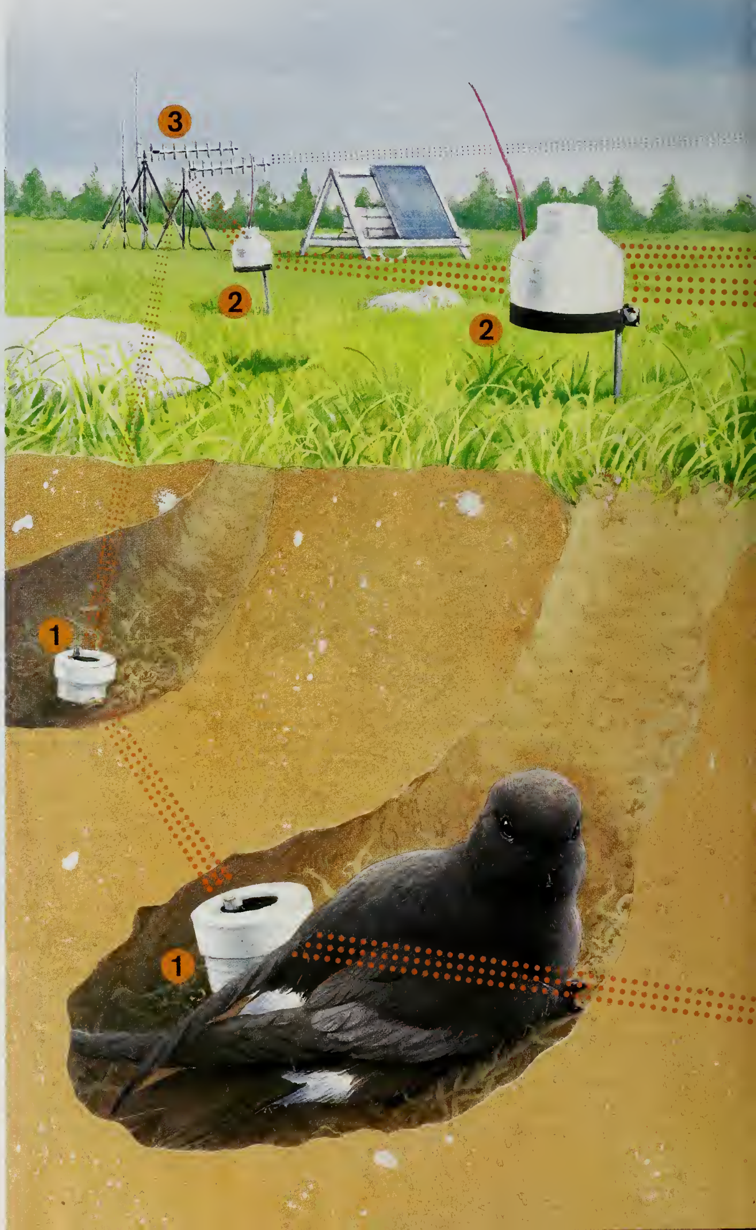
Once sensor nets liberate humans from the burden of computer interaction, there's no limit to how much silicon Intel can push. "I'm not going to have 10 computers per person," Gelsinger froths. "I'm going to have thousands of computers per person."

That vision represents a departure from business as usual in Santa Clara, California. Intel grew into the bluest of blue chips by hewing to Gordon Moore's famous observation about transistors, an axiom that has become a corporate strategy: Keep on building a chip that's twice as fast every 18 months, and everything will be all right.

The sensor game plan, on the other hand, has little to do with speed and a lot to do with size. Yes, the silicon that goes into each mote may eventually be dirt cheap. But when those chips are small enough to be blended into house paint or sewn into blue jeans, Intel will sell them by the billions. Smart dust? It could be ingenious. ■ ■ ■

THE ULTIMATE

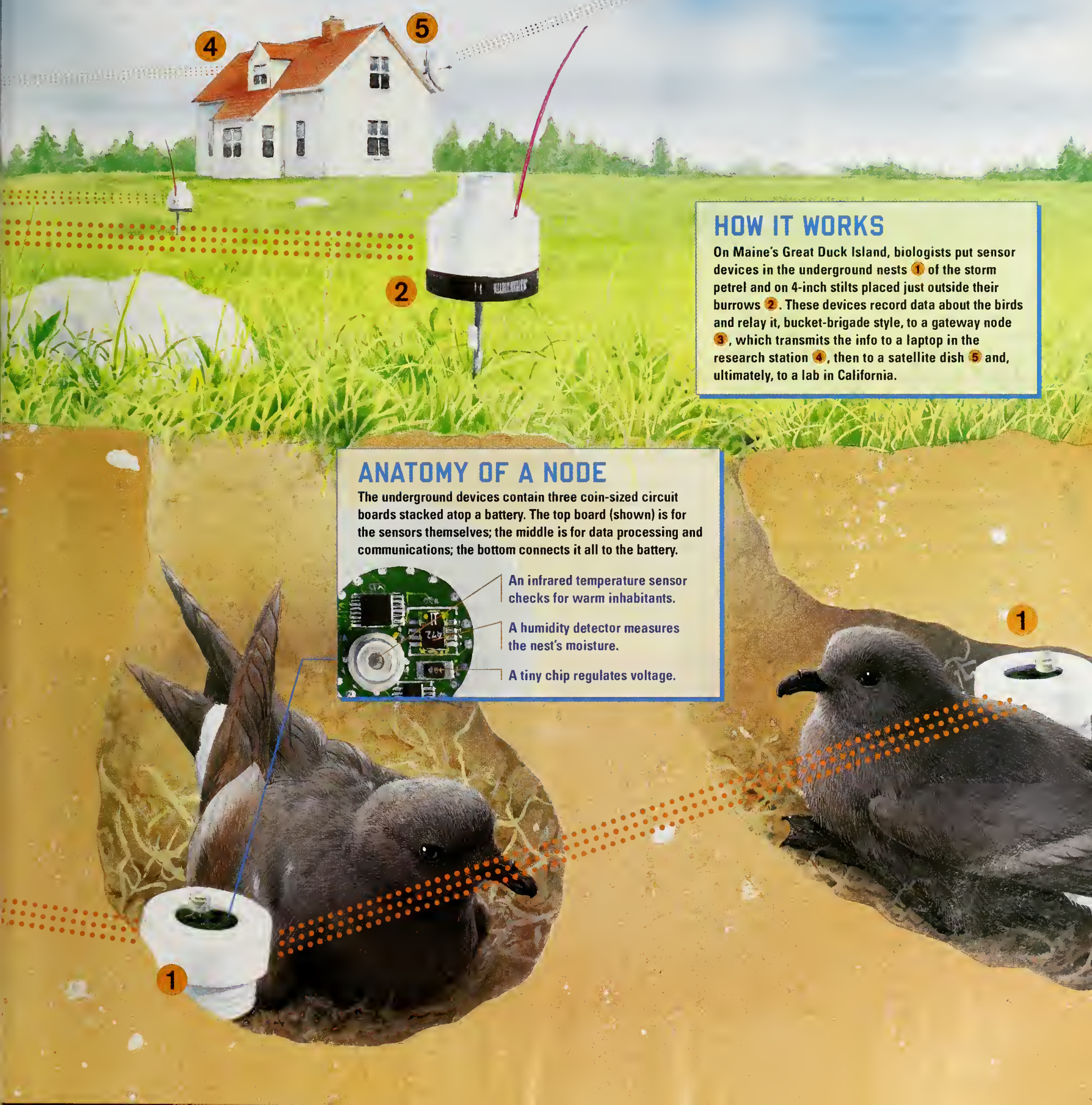
How a flock of reclusive seabirds became pioneers



ON-THE-FLY NETWORK

of pervasive computing. A case study from the sensor net frontier. **by Martha Baer**

ILLUSTRATION BY PETER SCOTT



HOW IT WORKS

On Maine's Great Duck Island, biologists put sensor devices in the underground nests ① of the storm petrel and on 4-inch stilts placed just outside their burrows ②. These devices record data about the birds and relay it, bucket-brigade style, to a gateway node ③, which transmits the info to a laptop in the research station ④, then to a satellite dish ⑤ and, ultimately, to a lab in California.

ANATOMY OF A NODE

The underground devices contain three coin-sized circuit boards stacked atop a battery. The top board (shown) is for the sensors themselves; the middle is for data processing and communications; the bottom connects it all to the battery.

An infrared temperature sensor checks for warm inhabitants.

A humidity detector measures the nest's moisture.

A tiny chip regulates voltage.

John Anderson is stretched out on his side, his right arm plunged to the shoulder in a narrow hole in the ground. He's grubby, his unwashed hair stuck to his forehead and sandaled feet in dire need of a scrub. His belly sags sideways in the brush. With a hard stare and deep concentration, he manages a few groping words: "Uh … there … nope." The accent is New Zealand laced with high Brit. As he lifts himself up, pulling his arm – now caked with dirt – out of the stiff foliage, he laments, "If we could just understand why here, why *this place*, it would be invaluable."

This place is Great Duck Island, a 220-acre arc of land off the coast of Maine with no year-round inhabitants and a summer population numbering in the single digits. It's served by solar panels that light up a handful of buildings, crude roads navigable only by tractor, and a boat that floats you to Bar Harbor in an hour and a half. There's no running water. On a clear day, you can see Mount Desert Rock, the most remote lighthouse on the East Coast.

I've come here to watch ornithologist Anderson and three Berkeley computer engineers install an early version of a wireless sensor network. This technology, made possible by the shrinking of the microchip and advances in radio science, is the next step toward pervasive computing. Cheap, mobile, and highly scalable, it's the best hope for dispersing information in a range of environments – office towers, vineyards, hospitals, caves, kitchens, battlefields, even the nesting grounds of birds.

It's those nesting grounds, rugged and isolated, that make Great Duck an ideal test bed for such a system. The Great Duck project will help determine whether this whiteboard concept – a battery-powered sensor network for collecting scientific data – can actually work in practice. The undertaking, a joint effort by the Maine-based College of the Atlantic, UC Berkeley, and Intel, aims to monitor the habitat of the Leach's storm petrel, a seabird whose lifestyle, including its preference for nesting in arm-length burrows, has made it nearly impossible to study. The tech team so far has deployed 190 devices, each the size of a shotglass, some inside the petrels' burrows and others just outside the entrances. The little instruments, called nodes or motes, house tiny sensors that monitor barometric pressure, humidity, solar radiation, and temperature. (By watching for temperature spikes inside a burrow, researchers can determine when a petrel is present.) The motes report the readings to a gateway node, sometimes passing the data among themselves, à la bucket brigade, bridging distances of up to 1,000 feet.

"We just don't *know*," says Anderson, dusting off. This is a sentence he will say over and over during my three days on the island, always emphasizing the last word with a peculiar combination of frustration and delight. And the subtext is always the same: At last, sensor nets will shed light on these most mysterious seabirds. Anderson says the new technology will change biology forever – just as it's likely to change high-end agriculture and civil engineering. "Up until now, a biologist from the 1920s could have dropped into today's world and understood everything we do." He shakes his head. "No longer." The instruments that unobtrusively observe the petrels will unleash a stream of information biologists have craved for decades. When I ask what other tool has delivered a comparable advance in his field, Anderson's answer is succinct and telling: "Binoculars."

Take a sensor, any sensor. The one embedded in the seat of your car, for example, which determines that you're present and that your seat belt should therefore be fastened and your air bag on alert. This sensor performs the same function in the same way on every outing. Powered along with the

"WITH THESE MOTES IT ALL COMES DOWN TO ONE QUESTION: WHAT HAPPENS WHEN THEY GET DIRTY?"

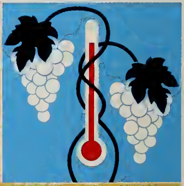
Writer at large Martha Baer (martha @wiredmag.com) wrote about extreme programming in Wired *11.09.*

A FIELD GUIDE TO REMOTE SENSING

One day, intelligent sensor networks will be full-service remote labs capable of interpreting and acting on information independently. But for now, they're the equivalent of superhuman grad students, collecting data from the far reaches of the planet – volcanoes and vineyards, South Pole ice and Southwest desert – and transmitting it back to the classroom for analysis. Here's a sample of projects in planning, testing, or operation. – **Dustin Goot**

AGRICULTURE

Okanagan Valley, British Columbia



THE RESEARCHERS: King Family Farms, Intel Research, AgCanada

THE LAUNCH: Spring 2003

THE SCOOP: A 65-mote grid spread across more than an acre of vines collects temperature data that helps growers determine which grapes to plant and where to irrigate. The network also delivers frost alerts and tracks temperature accumulation, a metric used by vintners to plan harvests.

THE PROMISE: High-yield viticulture. Intelligent networks will manage automated irrigation and crop maintenance schemes customized for each vine.

Biologist John Anderson goes elbow-deep in a burrow on Great Duck Island.

car's other electrical devices by a battery that's regularly charged, it gathers and dispenses information that travels no farther than a few feet. That's easy.

Now, what if the sensor wasn't stationary and had to transmit information over great distances; if it was required to handle multiple tasks, had no nearby power source, and wasn't readily accessible for repairs? All this would pose significant technical challenges. Nevertheless, researchers in recent years have faced down these constraints to make sensor networks a reality.

An Intel R&D team at UC Berkeley has led the way. Directed by David Culler, the hybrid "lablet" is on the verge of overcoming two great obstacles. First, communications. Scattered in large numbers out of easy reach, environmental sensors must work together, pooling skimpy radio-transmission resources and maintaining the network without human intervention. The solution: ad hoc, self-organizing, multi-hop networking, whereby each small instrument has the capacity to find and then pass messages to its neighbors.

Individual rules programmed into the mote's tiny computer orchestrate the sharing. Like members of a football team, the devices do individual tasks but can rely on other players for help. For instance, each mote might be assigned to record information from its onboard thermometer at a given interval, and then broadcast it. If a certain rank-and-file mote is far from the gateway node, it will locate the best messenger to pass its data along. The distant mote does this by checking the position and health of fellows in the network – information that each device announces regularly. Then, just as a quarterback looks for the most open receiver before making a pass, the mote considers its options. If one neighbor indicates that its last message took four hops to reach the node in charge, and another broadcasts that its last message took only two, our distant reporter chooses the latter.

The second problem, and the one that underlies all the rest, is the matter of fuel. Thousands of motes situated, say, at the tops of trees in an inexplicably ailing forest hardly invite frequent battery replacements. Nor would an extension cord up each trunk be an elegant solution. The trick is to use a small, inconspicuous battery so cleverly, with such thrift, that it can last as long as it's needed.

There are several ways to economize: Keep computations to a minimum; be stingy with the number of readings; compress or constrain the quantity of data sent, and use hops for long distances; and put devices to sleep between duties. Sleeping, not surprisingly, provides the best power savings, so the motes in sensor networks spend 99 percent of the time at rest. This raises another problem: How do you get a sleeper mote to wake up on schedule many times a day? One way is to incorporate a global alarm clock into the system, nudging the nappers when it's time to report new data. But all nodes can't call in at once – that would cause transmission bottlenecks. Meanwhile, some nodes will need to be roused not to do their own chores but to help pass buckets; how to schedule those interruptions?

"It's a very, very hard computer science problem," says Alan Mainwaring, who works

TESTING WATER

Palmdale, California

THE RESEARCHERS: Los Angeles County Sanitation District, UCLA, UC Merced, Loyola Marymount University

THE LAUNCH: Winter 2004

THE SCOOP: Los Angeles County wants to give treated wastewater to farmers for irrigation, but it must ensure that the water's nitrates don't trickle into groundwater at toxic levels. Instead of testing for nitrates by digging sampling wells, which catch problems after the groundwater is already contaminated, the plan is to bury sensors that track the pollutant as it seeps through the soil. When readings begin to get high, farmers know to stop spraying there for a while.

THE PROMISE: The end of the EPA as we know it. Sensors buried near dumping sites will alert polluters when they step over the line.

TESTING AIR

Carson, Washington

THE RESEARCHERS: AmeriFlux Network, UCLA, Center for Embedded Networked Sensing

THE LAUNCH: Fall 2003

THE SCOOP: Sure, forest canopies theoretically work as carbon sinks, but how do you gather data from a hundred feet up? Researchers at Wind River Experimental Forest measure carbon influx with bulky sensors hung on cranes. For more accurate figures, they're building the first self-adapting 3-D sensor network. Laptop-sized processing motes will crawl along cables strung between trees and lower weather and CO_2 sensors into the canopy on adjustable wires.

THE PROMISE: Geography-based pollution control. A factory's emissions allotment will depend on how much carbon nearby forests can absorb.

MICHAEL SCHMELLING

under Culler at the Intel lab and has spent the past two summers on Great Duck. "Should everyone wake up all at once? Should everyone know the whole topology of the network?" Mainwaring and his two colleagues on the project have dispensed with the idea of a universal clock. Their system uses what Culler calls low-power listening, in which motes sleep nearly all the time – but in intervals of milliseconds. This way, neighbors are constantly available for hops, as long as a sender catches another's attention within a minuscule, though extremely frequent, wakeful period. To make sure listeners can't sleep through an important missive, the system affixes a preamble to each message that's longer than the mininaps. When a mote wakes up, the preamble will still be transmitting, signaling the listener to stay alert for an upcoming message.

"YOU'VE SEEN THE CUTE BUNNIES? THEY'RE WILD HARES, AND THEY CHEW THROUGH OUR ETHERNET."

Once you've got the motes awake, of course, you still can't demand much of them. Every computation, every transmitted byte, has a price in power. Culler's group has dealt with these limitations by creating TinyOS, an extremely simple open source operating system. This code manages the radio functions of the machines and handles data drawn from the sensors (converting barometer readings, for instance, from analog to digital, then storing them, compressing them, or just passing them on). It allows motes to locate neighbors, assembles messages, and determines routes. All of this with the simplest, lightest logic system. An entire TinyOS message requires about as much space as the routing instructions alone for a standard email.

Out on the island, TinyOS is gathering data from seven different types of jelly bean-sized sensors. Some are installed on motes planted inside petrel burrows. Some stand aboveground on 4-inch-tall wire posts, recording nearby conditions. Every 5 minutes, each mote sends its observations to the gateway mote, which has a wide-area antenna and plenty of juice from a set of solar panels. It passes the data to two more powerful directional antennas, also sun-fueled, that dispatch the packets to an even larger antenna sprouting from the weathered research station. Laptops inside the building forward the data again, this time to a satellite dish facing out to sea. At one point last summer, 102 motes were beaming information across 50,000 miles, from the meadows of Great Duck into space and then to the lab in Berkeley.

"Intel had this cool technology, but they didn't have any questions to answer. *I* have endless questions," Anderson says. We are walking from the sensor patch toward the gabled white home that served as residence for the island's head lighthouse keeper until 1986. Today the stark building contains a half-dozen bare mattresses, a single sunken couch, and a table around which the three Berkeley geeks sit, staring at their laptops. "What climates make the chicks thrive?" Anderson asks, giving me a taste of the endless questions. "Which burrows are preferable? Why do birds drag little spruce pine-cones into their nests? We just don't *know*."

Anderson's relentless curiosity is well suited to tracking these elusive birds. Called petrels because, like the apostle Peter, they seem to walk on water as they skitter across the surface looking for food, the fluffy, black, 2-ounce creatures live dozens of miles out at sea. Unlike the albatross, they're rarely seen hovering in the wake of boats. When they come to land to roost for seven months each year, they huddle in tunnels all day. Only very late, long after dark, do they emerge, flitting across the sky like bats, heading out to sea to harvest food. Studies of some migratory birds – varieties with legs hefty enough that researchers can ring them with electronic tags – reveal their movements, nesting preferences, yearly itineraries. For creatures as small as petrels, however, there's no good way to track them. Even the simplest analysis is tricky: Unlike other birds that come yearly to Great Duck

FIGHTING DESERTIFICATION

Chihuahuan Desert, New Mexico

THE RESEARCHERS: Long Term Ecological Research Network, Jet Propulsion Laboratory

THE LAUNCH: Summer 2003

THE SCOOP: At the Sevilleta Field Station, scientists are studying the creosote bush, a shrub that creates a kind of mini greenhouse effect, making it an early sign, and perhaps a cause, of expanding desert. Temperature, moisture, and light sensors are being placed around three creosote bushes – in the leaves and surrounding soil – and connected to a mote at the central server. The data will be compared with readings taken from juniper and mesquite bushes and from open areas.

THE PROMISE: The dune stops here. More broadly, a deeper understanding of microclimates.

FIGHTING FIRE

Claremont Canyon, California

THE RESEARCHER: UC Berkeley

THE LAUNCH: Summer 2004

THE SCOOP: How hot is a forest fire? The answer is invaluable, though difficult to obtain. Heat gradients are important for learning where a fire is spreading and when adjacent trees will flare up. UC Berkeley's FireBug project consists of golf ball-sized sensor motes that can be dropped ahead of an inferno and send data back out. The research team has gone through fire training, and a test is planned for a controlled burn next summer. Over time, scientists hope to deploy sensors in the wilderness as a way to anticipate hot spots.

THE PROMISE: A new age of firefighting. Proactive monitoring with smart dust will prevent forest fires.

– roughly 1,000 guillemots, 1,300 eiders, 1,200 herring gulls, and 50 black-backed gulls – it's awfully hard to count petrels. In 80 years of study, biologists have had no recourse but to reach down into their nests and feel around. One College of the Atlantic grad student made a valiant attempt to tally the birds by threading a camera typically used to examine sewer pipes into several of the island's burrows. She estimated there were 9,300 pairs of the birds, give or take 6,500. It's the best reckoning Anderson has ever gotten. "We definitely have the largest known population in the Lower 48," he says. "Maybe there are others. We just don't *know*."

The sensor net will finally get Anderson up close to his mysterious animals. Already, it has produced data that helps explain the birds' nesting choices. Despite discrepancies in temperature readings from the aboveground motes, the burrows' interior conditions are proving highly consistent. Whether the outer motes are planted in the warm air of the meadow or the cool shadows of the forest, the burrows' inner chambers remain about 54 degrees Fahrenheit. What seems to matter, then, isn't so much the island's microclimates as its soil.

The sensor technology has also opened new avenues of inquiry. Watching the temperature readings climb and fall over the course of days, Anderson has confirmed that petrel parents spend an unusual amount of time away from their eggs during incubation and from their chicks once they're hatched; neither eggs nor chicks, it seems, mind the cold. "This," he says, "raises some important physiological and developmental questions."

In the long run, Anderson hopes to use the sensor network to locate undiscovered groups of petrels, as well as roosting populations of other species on islands where landing conditions permit only a visit or two each year. Finding thousands of petrels living differently elsewhere – tunneling into less spongy soil, for instance, or settling in chillier burrows – would go a long way toward revealing the shy creatures' habits. Instead of checking on the birds one at a time or even monitoring them remotely by the hundreds, Anderson wants to compare and analyze the behavior of thousands of birds over a dozen islands.

There are eight of us wandering about in the woods, the peaty soil sinking several inches under our feet. The gray light of an overcast sky is filtering through ancient mossy growth. Up ahead, Anderson is on his hands and knees, crawling under the lowest branches of a spruce looking for an active burrow. (If a sprinkle of freshly dug soil has collected at the mouth of a burrow, it's likely some petrel has chosen it as home.) Several COA students follow behind, one planting a numbered red flag at every spot where Anderson decides to place a mote; one carrying a GPS receiver, much like a flag-bearer for a marching band; and one dutifully recording the coordinates. The device is encased in plastic that allows radio frequency *out* but won't let the sun's heat *in*.

A wunderkind Berkeley engineering student who works with Mainwaring, 23-year-old Joe Polastre, urges us to go deeper into the woods. He wants to push the system to test how it will handle multi-hops. Anderson is more interested in a nearby burrow that he believes contains an egg. After a brief conversation, a mildly irritated Anderson gives in and agrees to choose farther-flung nests. The mosquitoes get worse.

What makes this itchy trek in the woods significant for sensor networks is precisely that it takes place in the woods – real, honest-to-goodness woods. So far, developers of sensor networks have faced their challenges and celebrated their breakthroughs from the comforts of the lab. They've set up PDA-sized devices around their cubes and in hallways and cheered when they saw their routing schemes function as expected. For Mainwaring, though, the Great Duck network is not a test of whether the system can work. He knows it can. It's a test of whether it works under real conditions. Every rain-soaked or silent instrument is key to the project. "With these motes," he says, reducing the experiment to a single sentence, "it all comes down to one question: What happens when they get dirty?"

That's why, as we pick through the spruces, we pass the elements of an additional layer of technology: heavy plastic suitcases sprouting cords. This secondary setup is devoted solely to verifying the first system. It's made up of five cameras buried in the ground above five different nests, deep enough that the lenses poke slightly into the burrows' inner chambers. These infrared devices will deliver hazy images of any animals present to corroborate the motes' occupancy readings. As temporary

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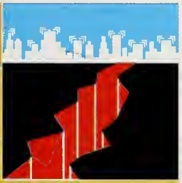
SEISMOLOGY
San Gabriel Mountains, California



THE RESEARCHERS: UCLA Department of Earth and Space Sciences, Center for Embedded Networked Sensing

THE LAUNCH: Spring 2004

THE SCOOP: Sensor networks don't just work in small spaces. UCLA professor Paul Davis will install a ladder of 50 networked seismometers – 25 on either side of the San Andreas Fault – to analyze the movement of giant tectonic plates. The ruggedized devices, each the size of a briefcase, will record even faint rumbles, allowing Davis to calculate the depth of the fault and pinpoint locations where stress is accumulating. Understanding stress could lead to better forecasting.

THE PROMISE: An early warning before the big one.

SPACE EXPLORATION
MacAlpine Hills, Antarctica

THE RESEARCHERS: Antarctic Search for Meteorites, Jet Propulsion Laboratory

THE LAUNCH: Winter 2002

THE SCOOP: Space buffs are turning to sensor networks to advance the search for life on Mars. The plan: establish a virtual presence on the Red Planet through sensor pods, which could scope out terrain and direct rovers to areas that might support life. Last winter, researchers tested a 14-node cluster in Antarctica, partly to assess the equipment's mettle in cold, harsh environments. On future Antarctic trips, scientists hope to test sensors designed for detecting signs of life such as CO_2 or methane.

THE PROMISE: Astronauts become obsolete. Rovers will set up mote-enabled virtual labs on the cheap.

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- David Byrne's most recent project is *Envisioning Emotional Epistemological Information*, a book of artwork done with the ubiquitous presentation software PowerPoint. "I have been working with PowerPoint as an art medium for a number of years. It started off as a joke (this software is a symbol of corporate salesmanship — or lack thereof), but then the work took on a life of its own as I realized I could create pieces that were moving, despite the limitations of the 'medium'."
- Best known as one of the Talking Heads, Byrne has been making visual art for more than 25 years and is represented by Pace/MacGill Gallery, NYC.
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◀245 test instruments, the cameras are powered separately from the wireless net, using cable that doubles as electrical cord and Ethernet – power in, data out. A large server, lodged in a watertight case, sucks electricity through extension cords that run back to the island's main photovoltaics. This validation system comes with its own set of problems. Says Mainwaring: "You've seen the cute little bunnies? Actually they're wild hares, and they've chewed through our Ethernet."

By the time we finish our hike, we've placed 14 more devices in the ground and fixed several cameras. Back inside, the team stands around a laptop watching numbers appear. "Everyone's reporting," says Polastre. The newly installed motes, loaded with chips and sensors, are sending packets from one to the next, then to the gateway node, then via solar-powered antenna to a database on a computer here in the house. Polastre pulls up a record of motes installed two weeks earlier, showing off a graph of occupant temperatures dropping as an adult petrel departs into the night. Mainwaring launches a fuzzy video feed from one of the validation cameras, revealing in real-time the tiny movements of a bird twitching and breathing as it roosts.

As I leave the island, my feet are covered with bites and the grime around my neck is scary. I can't wait to splash my face in the first sink I find.

We trudge to the boathouse, where a spacious metal rowboat that the captain calls a pea pod is cinched, with the help of a diesel-fueled pulley, to the top of a ramp. After the craft is packed with our gear, one of the students releases the pea pod, which slides at a frightening clip some 160 feet down to the water. In this low tech manner, Great Duck islanders, otherwise trapped on land by a ring of lethal rocks (Anderson warns of RTMs – "rocks that move"), can escape the wilderness.

From the bottom of the ramp, we row out to a 35-foot former lobster boat called *Indigo*. It will deliver us to the mainland. The surf is bumpy. We pitch unpredictably, our narrow paddles a remarkably inefficient means of propulsion, and I think for a minute of the latest round of sensor readings, which have already reached California. ■ ■ ■

←229 cried out, "Six syllables!"

Teaching Matt was a challenge – at first, he would strike a single note on the piano and run to the back of the room to stand on his head. But Eyran Katsenelenbogen was an empathetic teacher. "I have always performed and recorded solo," he says. "There's something slightly autistic about that."

Matt progressed quickly. Other students would learn two or three pieces in a lesson, while Matt would tear through a dozen. Katsenelenbogen came to see a connection between Matt's hyperspeed number-crunching and his jazz mind: "Matt has an amazing ability to calculate relationships between chords and lines, which can all be expressed in numbers."

As we finish lunch, Matt asks me in his distinctively high-pitched voice, "Did you know that numbers can be friendly and amicable?" He means friendly and amicable in the math-geek sense – numbers that can be factored into one another – but I also felt he was using those words in their ordinary sense. Matt is intimate with numbers. They come to him in dreams and inspire him to write songs. One of his tunes on the album *Groovin' on Mount Everest* is called "Forty-Seven" – a number he feels is "lonely" because when he asks people to think up a random number, no one ever chooses it.

THEIR BRAINS ARE HARDWIRED TO "EXTRACT UNDERLYING RULES THAT GOVERN A SYSTEM."

The philosopher-mathematician Gottfried Leibniz called music unconscious counting. The music of Matt's consciousness is mathematics.

Geneticists are starting to pinpoint the DNA anomalies found in kids like Matt who are savants from birth. Still, a single savant gene will probably never be found. More than a dozen genes may contribute to autism. Several other forms of mental impairment also produce islands of startling ability – known as splinter skills – as if fragments of savant code are scattered throughout the genetic database.

Last year, researchers at Vanderbilt University discovered a cluster of abnormalities on chromosome 15 in the families of autistic savants. Another set of irregularities on the same chromosome produces learning-disabled kids who can solve jigsaw puzzles twice as fast as other children and have an insatiable desire to overeat – Prader-Willi syndrome. A third chromosomal disorder, called Williams syndrome, results in mental retardation, poor coordination, and a different set of splinter skills. Williams kids, who have distinctively elfin facial features, are naturally outgoing, love to schmooze, and have a propensity for florid verbal constructions (hyperlexia), similar to Matt's discourse on proportions.

Like savants, people with Williams syndrome have an unusual relationship with the audible world. Some are terrified as children by the hum of household appliances, but others become connoisseurs of the rich drones of machines, like a boy described in the clinical literature who had a collection of 18 different vacuum cleaners. Many people with Williams also excel at picking out the notes in a chord. Some are so sensitive that they can identify the make and model of a car from the sound of its engine.

In tests conducted at a music camp in Massachusetts, psychologists found that the errors made by Williams kids were more *musical* than those made by a control group. On a clapping test, those in the control group sometimes just dropped the beat, but the Williams kids made mistakes that elaborated on the rhythms. They were jamming.

In the same way that Matt's mind is made of math problems, the minds of Williams syndrome kids are made of sound. As one girl told a researcher, "Music is my favorite way of thinking."

In the 1980s, the search for a single cause underlying the various forms of savant syndrome led neurologists Norman Geschwind and Albert Galaburda to propose a bold theory that would account for autism, dyslexia, stuttering, and a number of other disorders that seem to have a basis in left-hemisphere dysfunction.

Male savants outnumber females 5 to 1. The problem, hypothesized Geschwind and Galaburda, is testosterone.

The nerve cells in a fetal brain proliferate at an astonishing rate, with 250,000 neurons born every minute. These cells are engaged in a fierce Darwinian contest. The goal: interconnectedness.

In a fetus that is developing normally, those neurons that do not form synaptic links with the other cells are killed off before birth. After eight weeks of gestation, the testes in a male fetus start pumping out nearly as much hormone as they will at puberty, and Geschwind and Galaburda theorized that in some brains, this flood of testosterone interferes with the assembly of the neural network, resulting in a tangle of miswired connections.

A breakthrough study published in July supports the notion that in autistic savants, something goes wrong in this cycle of growth and pruning. Eric Courchesne at UC San Diego found that most autistic children are born with brains that are smaller than normal. In the first year, however, their brains grow dramatically until they're larger than normal, reaching maximum size at age 4 or 5 – eight years earlier than the brains of most people.

The brains of typical children grow in response to lessons learned from the environment – that was one of the significant upgrades in the evolution of *Homo sapiens*. As new stimuli are absorbed, the neurons in the cortex adapt gradually, and synaptic connections are forged or eliminated. Our brains are cast in the image of our experience.

The overgrowth of the brain tissue of autistic kids, however, is random and automatic, a reaction to an unknown stimulus – perhaps testosterone or some toxic agent in the environment. The result, says Courchesne, is an onslaught of neural noise that makes the infant lose the ability to make sense of its world.

The director of the Autism Research Centre at Cambridge University, Simon Baron-Cohen, makes the case in his new book *The Essential Difference* that autism represents an extreme manifestation of the "male brain." In his view, male brains are hardwired for "extracting the underlying rules that govern a system." (He carefully adds, "Your sex does not determine your brain type.") While the jury is still ➡

◂ out on testosterone, a set of clinical studies in the UK confirm that both male and female savants are better at extracting the rules that govern systems than normal people.

Psychologists Beate Hermelin, Neil O'Connor, and John Sloboda hosted a neuromusical battle of the bands between a 19-year-old musical savant and a professional pianist. The researchers played Edvard Grieg's "Melody" and a selection from Béla Bartók's "Mikrokosmos" for both and asked them to reproduce the pieces from memory.

The savant recalled all 64 bars of "Melody," striking wrong notes only 8 percent of the time. (He played the piece equally well, without hearing it again, the following day.) The professional pianist, however, remembered less than half the piece and hit 10 times as many wrong notes. The professional pianist fared better on "Mikrokosmos," making not nearly as many mistakes, though he still recalled far fewer notes than the savant. By analyzing all of the performances, the researchers concluded that the savant memorized Grieg's piece more easily than Bartók's because "Melody" obeys the rules of classical diatonic form – rules that he had already extracted in the normal course of listening to music. But Bartók's music intentionally breaks those rules. The professional pianist simply played back whatever notes he heard. For the savant, trying to reconstruct "Mikrokosmos" was like trying to recall syntactic structures in a language he didn't speak.

THE CALCULATING TWINS WOULD SWAP SIX-DIGIT PRIMES, FOR HOURS.

Hermelin and her colleagues found that savants also use rule-based strategies for calendar calculating. For a long time, the assumption was that they memorized tens of thousands of day-date pairings during months of obsessive practice. But as in music, the researchers discovered that when figuring dates in the distant past or future, savants supplement their prodigious memories with algorithms they derive from the cycles of the calendar.

In *The Man Who Mistook His Wife for a Hat*, Oliver Sacks wrote memorably about the calculating twins, George and Charles, who amused themselves for hours trading six-digit prime numbers with what Sacks described as "holy intensity." The twins were incapable of performing even simple multiplication. They told Sacks that they saw prime numbers just appear in their minds.

In most savants, these processes are as invisible to them as our own cognitive strategies are to us. Matt Savage, however, is able to watch his own autistic brain at work. When I ask him to explain how he determined that I was born on a Monday, he patiently draws a grid in my notebook illustrating the algorithm he applied.

To understand how even profoundly retarded savants can do such complex calculations subconsciously, Darold Treffert says, requires an examination of one of the oldest, least-evolved regions of the brain: the primitive storehouse of memory.

Trim and soft-spoken at 70, Treffert met his first savants in 1962 at a Wisconsin state hospital where he was assigned to found a new children's unit. One young patient named David had memorized the timetables for the entire Milwaukee bus system; given a route number, he could announce the scheduled location of a bus at any time of day. Another boy, Tony, would rattle off an exhaustive list of historical events that occurred on that day. He sounded "like the radio announcer on the morning show I listened to on the way to work – except that the announcer read it from an almanac. Tony *was* an almanac," Treffert wrote in *Extraordinary People: Understanding Savant Syndrome*.

There is no single unified memory function in the brain. Just as there are many types of remembering – retaining a phone number long enough to dial it, recollecting Proustian panoramas after a bite of madeleine – there is a diverse set of subsystems for imprinting experience in the mind.

The memories of savants run deep but narrow. They can recite, forward or backward, the contents of a book they've read and tell you the number of steps they took to the store. Their memories are high-fidelity – concrete, precise, and comprehensive – but there is little emotion in them. Musical savants are frequently described as human tape recorders.

This oddly adhesive memory is what binds together every domain of savant skill. In the brains of savants, Treffert believes, associative memory systems located in the higher regions of the cortex fail, and older parts of the brain – the ancient pathways in the basal ganglia known as habit memory – take over.

Habit memory is Pavlovian, an archive of involuntary stimulus/response loops – the memory that never forgets how to ride a bike. To reproduce a Bach sonata with slavish accuracy requires an inner tape recorder and a book of rules. But to play Bach with fire and originality requires Proustian memory, with its nuanced webs of association and metaphor. This higher-order memory, like a living text, is constantly under revision. It's not just that savants remember everything, says Treffert, it's that they are unable to forget anything, like the protagonist in Jorge Luis Borges' short story, "Funes the Memorious."

Treffert is convinced that some savants don't have to learn the algorithms involved in tasks like calendar calculating. The software comes preinstalled. "You have to go beyond talking about traits," he says, "and start talking about the genetic transmission of knowledge."

The drawing abilities of most savant artists, for example, burst forth with no preparation, no training, and no practice – as if their skills were already there, fully fledged, needing only access to a pencil or a brush.

Children who seem to come into the world with profound artistic gifts have been objects of fascination for centuries, but recent discoveries suggest we may all carry a savant inside us waiting to be born.

One of the first researchers to propose this radical notion was UC San Francisco neurologist Bruce Miller, who noticed that certain people diagnosed with frontotemporal dementia, or FTD, suddenly develop aptitudes for music and art when their language faculties are ravaged by the disease.

One patient of Miller's, a 78-year-old linguist, began composing classical music soon after the onset of dementia, though he had little musical training; he felt that his mind was being "taken over" by notes and intervals. Another patient, an established landscape artist, turned toward abstraction and painted even more expressively as her verbal skills declined. Brain scans of FTD patients confirm patterns of damage similar to those found in many savants.

As the disease progresses, these patients experience curious perceptual alterations, becoming more attentive to textural details, visual patterns, and sounds. They become obsessed with their new creative pursuits just as savants do with their timetables, maps, and daily routines. The landscape artist, a 57-year-old woman, stopped working alone in her studio and began sketching people in cafés and painting nudes.

Miller formulated a provocative hypothesis to explain the fact that as some FTD patients get worse, they also get better. He posited that the dementia does not create artistic powers in these patients, it *uncovers* them. The disorder switches off inhibitory signals from the left temporal lobes, enabling suppressed talents in the right hemisphere to flourish.

This ability of the brain to heal itself and compensate for loss of function is called neuroplasticity. But the brain's ability to redraw its own cortical maps on the fly is not limited to routing around damage.

In Germany, a young man named Rüdiger Gamm, who is not autistic and did poorly at math in school, has trained himself to divide prime numbers to the 60th decimal point, calculate fifth roots, and raise numbers to the ninth power in his head – skills previously thought to be the lofty province of math geniuses and savants like the calculating twins.

People typically use short-term memory to solve math problems, but PET scans show that Gamm has recruited areas of his long-term episodic memory – the neurological archive of his life story – to perform his lightning calculations. Brian Butterworth of the Institute for Cognitive Neuroscience in London compares what Gamm is doing to the way "computers extend the capacity of RAM by using swap space on the hard drive to create a larger 'virtual memory.' "

A decade ago, this kind of DIY cortical hacking would have been strictly Philip K. Dick territory, but neuroscientists are discovering that the processing centers in our heads swap resources all the time.

When most people listen to a piece of music, they track melody with the right hemisphere and rhythm with the left. But among professional musicians, both are tracked with the left, which handles behaviors that have become routine. MRI scans show that skilled violinists have enlarged areas of tissue in the left planum temporale, an auditory crossroads that serves both music and language.

The left planum temporale is also home to one of the most enviable savant skills, called absolute pitch. Mozart had it when he was 7 – a family friend wrote that "on hearing a bell toll or a clock, or even a pocket watch, strike, he was able at the same moment to name the note." While relative pitch (the ability to judge that one note is A after being given another note, like C) is common, absolute pitch is considered rare even among professional musicians. But many people with Williams syndrome have absolute pitch, as do nearly all musical savants.

Diana Deutsch, an expert in music cognition, discovered that, as children, we all may have had Mozart's ear for identifying notes but then lost it – unless we were lucky enough to grow up speaking tonal languages such as Mandarin, Cantonese, or Vietnamese. It turns out that speakers of these languages use absolute pitch every day, but in conversation, rather than in the concert hall.

Deutsch digitally compared recordings of native speakers of Chinese and Vietnamese saying the same phrases on different days. In Mandarin, *ma* can mean *mother*, *horse*, or *hemp*, with the rising or falling tones determining the meaning. The tones employed on different days were remarkably consistent, varying as little as a quarter of a semitone, the smallest interval in Western music.

"It looks as though there's a critical period when every infant has the opportunity to learn absolute pitch, *if* they grow up in a culture where pitch is associated with meaning," Deutsch explains. By starting music training early, every child might be able to preserve this inborn ability.

As new research reveals more areas of untapped potential in the brain, some neurologists are asking whether there might a way for the average person to switch on these hidden skills without having to suffer the kinds of brain trauma seen in Miller's dementia patients. In a laboratory in Australia, one self-styled revolutionary has taken up the cause of liberating our inner savant from the benevolent tyranny of the left hemisphere.

Trained as a physicist, Allan Snyder helped usher in the modern fiber-optics era with his breakthroughs in optical waveguide transmission in the 1960s. At the Centre for the Mind in Sydney, Snyder has built on the work of Treffert, Sacks, and others to suggest that autistic savants have "privileged access" to the mind's raw data before it's parsed and filtered by the brain's executive functions.

Musical savants, in his view, have absolute pitch because they tap directly into the discrete frequency receptors in the cortex without any left-hemisphere meddling. Savant artists draw with exceptional accuracy, he says, because "they see the world as it really is."

"Our knowledge and expertise blind us," Snyder told me last spring. "If we could switch off our conceptual mind, we could have a momentary literal viewing of the world."

Where Snyder and his mentors part ways is on how to go about switching off the conceptual mind. His method is to create a "virtual lesion" in the left temporal lobes by bombarding them with magnetic pulses, using transcranial magnetic stimulation. Volunteers given TMS, Snyder says, draw more naturalistically, and their proofreading skills also improve, because they see what's in front of their eyes, rather than what their conceptual minds think they're seeing. Profiled in *The New York Times Magazine* last summer in an article called "SAVANT FOR A DAY," Snyder has captured the imagination of the press by predicting that someday, anyone will be able to don a TMS "thinking cap" and boost their creativity with a dose of savant-style cognition.

There's only one problem. Researchers at Flinders University in Adelaide, Australia, couldn't replicate the results of Snyder's experiments. Volunteers who received TMS showed no statistically significant improvement on tasks at which savants typically excel, except for a small increase in a test related to long-term memory. Some skills actually declined slightly.

Treffert, who has been studying the minds of people like Matt for 40 years, is skeptical of Snyder's shortcut to accessing savantlike skills. "The likelihood of significant savant abilities emerging in a 10- or 20-minute TMS session in normal volunteers is, in my view, zero."

Oliver Sacks, whose books inspired Snyder to enter the field, visited the ➡

Centre for the Mind last year. Sacks' own session under the thinking cap, however – now immortalized in a photo on Snyder's Web site – lasted only a few minutes. "It gave me a headache," he recalls, "or rather, a *face* ache."

But Sacks' conversations with Treffert and Snyder have led him to reconsider his statement in *The Man Who Mistook His Wife for a Hat* that autistic savants are "a strange species in our midst, odd, original, wholly inwardly directed, unlike others." These days, Sacks is weighing the possibility that savants may be more like us than he thought.

"It's the isolation of powers in the savant that is so peculiar, but one might say the same about many people – particularly musicians. I now think that the presentation of great musical powers may be rather similar in the savant and in the future composer." The crucial difference, he adds, is that the musical gifts of savants "fail to develop in the same creative way" as the skills of future composers.

Sadly, in many cases, their gifts fail to develop at all. The artistic powers of a celebrated savant named Nadia – a British girl who began drawing at age 3 with more accuracy and subtlety than many adult artists – ebbed at age 9, when she learned to speak. The brilliant careers of many musical prodigies are cut short in adolescence, when innate talent must become a craft and a left-hemisphere routine. Many savant life stories follow a difficult trajectory from an astonishing debut to an anonymous fate.

AT AGE 3 HER ARTISTIC GIFT WAS AMAZING. IT VANISHED WHEN SHE LEARNED TO SPEAK.

"When Matt was very young," his mother tells me, "it was difficult for me to imagine a future for him."

Matt's future as a musician will be determined by what is still a neurological mystery: creativity.

For most of the 20th century, intelligence was viewed as an all-purpose, monolithic power, christened *g* by psychologist Charles Spearman. Creativity was believed to be a side effect of a high level of general intelligence – a mark of big *g*.

The father of the standardized-testing industry, Lewis Terman, created the Stanford-Binet Intelligence Scale to quantify this power. He launched the longest scientific study in history, *Genetic Studies of Genius*, to track the accomplishments of highly gifted grade-school children through the course of their lives.

His hope that an impressive IQ score would augur groundbreaking accomplishments in science and art, however, didn't pan out. His young Termites, as he affectionately called them, did end up earning slots at better universities and getting hired for executive positions, often with help from Terman. They gave the world two memorable inventions: the K ration and *I Love Lucy*. (Both Ancel Keys, who perfected single-meal pouches for the US Army, and Jess Oppenheimer, the creator of the popular TV show, were Termites.)

For the most part, however, real genius slipped through Terman's net. None of his prodigies won major scientific prizes or became important artists, while two students excluded from the study for having insufficient test scores, William Shockley and Luis Alvarez, went on to earn Nobels.

Howard Gardner rallied the anti-Terman forces in 1983 with his influential book *Frames of Mind*. In place of *g*, Gardner proposed seven modular faculties in the brain, each with its own stronghold of competence. Savants seemed to be the living proof of his theory: In the case of Nadia, while her linguistic intelligence was impaired, her spatial intelligence was highly developed. Gardner compared these separate but equal modules of intelligence to highly tuned computational devices.

But, like Terman, Gardner missed something: the difference between computation and creativity. If a bottomless literal memory and a set of algorithms were enough to make us significant artists and composers, our iPods and museums would chronicle a history of savant breakthroughs. The computational abilities of savants may give them glimpses of the world as it really is, as Snyder says. But creativity is also the ability to imagine the world as it is not – to make conceptual leaps and refine the raw data of experience into abstract ideas, meaning, and insight.

That is precisely the function of the most recently evolved areas of the brain – the regions of the prefrontal cortex that are damaged or impaired in many savants.

Sacks maintains a personal shrine to creative intelligence over his desk in Greenwich Village. There, his friends smile from a collection of photographs: the chemists Roald Hoffman and Linus Pauling, the virologist D. Carleton Gajdusek, the playwright Jonathan Miller, the neuroscientist Vernon Mountcastle, and a 19-year-old wunderkind, Nick Younes, whom Sacks calls Big Nick.

"These people are very unlike savants," he explains. "They're people of great all-around *g*. One feels it strongly in the size of someone's universe, its depth and spaciousness, in their intellectual agility, and in the power of generalizing, which seems to cross all the particular modalities."

The mark of real genius is that it leaves its own domain permanently changed. After a century of dissecting the cortex into smaller and smaller bits, we're learning that the highest functions of the mind – creativity and imagination – are emergent properties of a brain working as a whole.

And a rare mind like Matt's is the product of something even larger than that: a social network. His parents introduce him to other musicians, buy him CDs so he can learn from musical innovators of the past, and find teachers like Katsenelenbogen. (I once asked Matt if he was familiar with Miles Davis' *Kind of Blue*. "Every jazzman," he sniffed, "knows *Kind of Blue*.") They also know when it's time to stop taking calls from talk-show bookers and just let him be a kid, at home among his melodies and his numbers again.

On a stage in Florida, Matt sits down at a piano in front of a sold-out audience to record an album called *Chasing Your Tail*. His trio takes liberties with seven original tunes and three standards – "Body and Soul," "Chelsea Bridge," and "My Favorite Things." As he plays, he rocks from side to side because his arms are too short to span the keys.

The notes pour out of him, as if they had a mind of their own. ■ ■ ■

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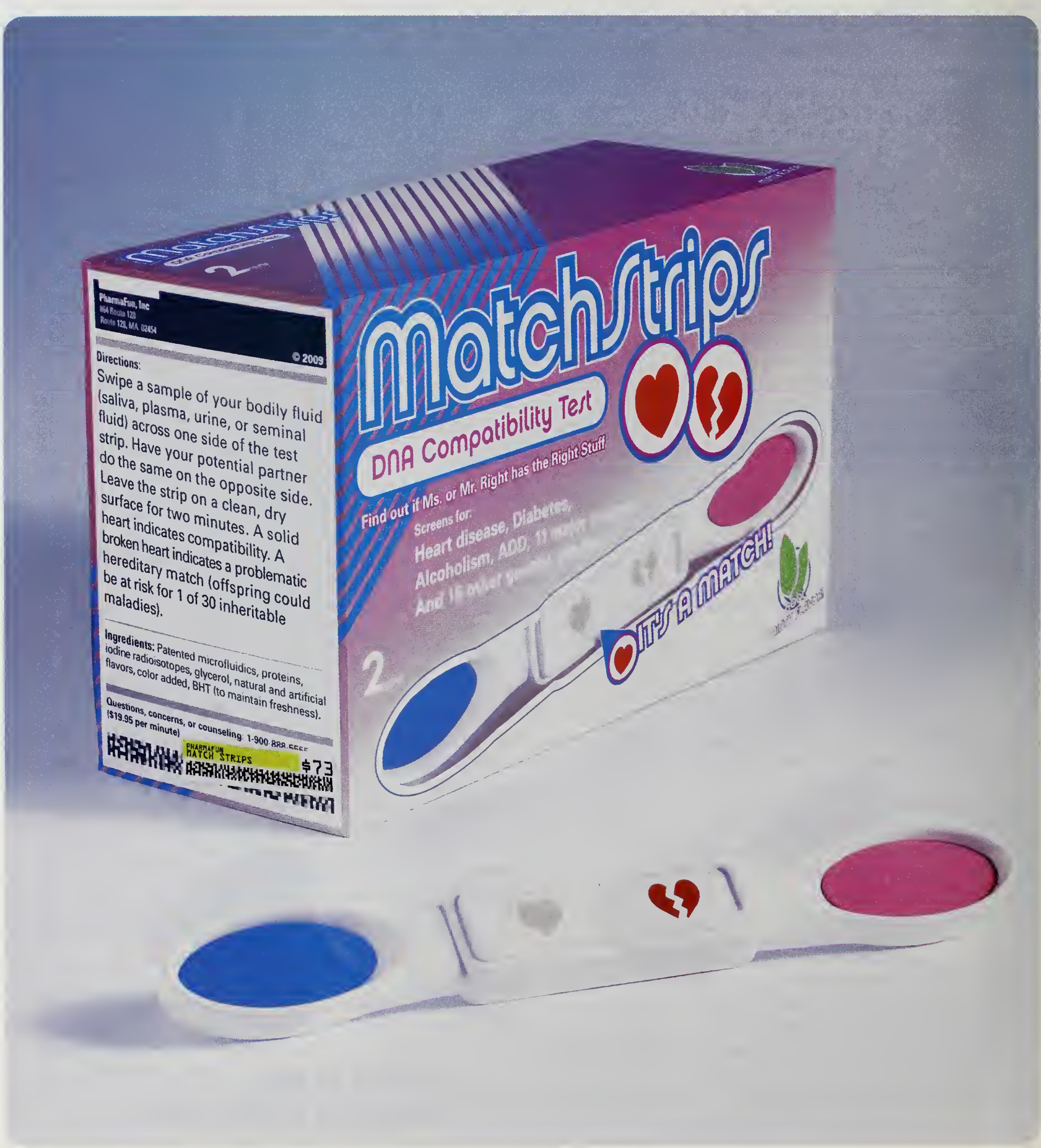

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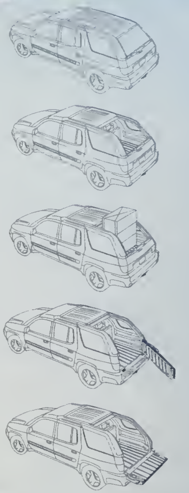

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